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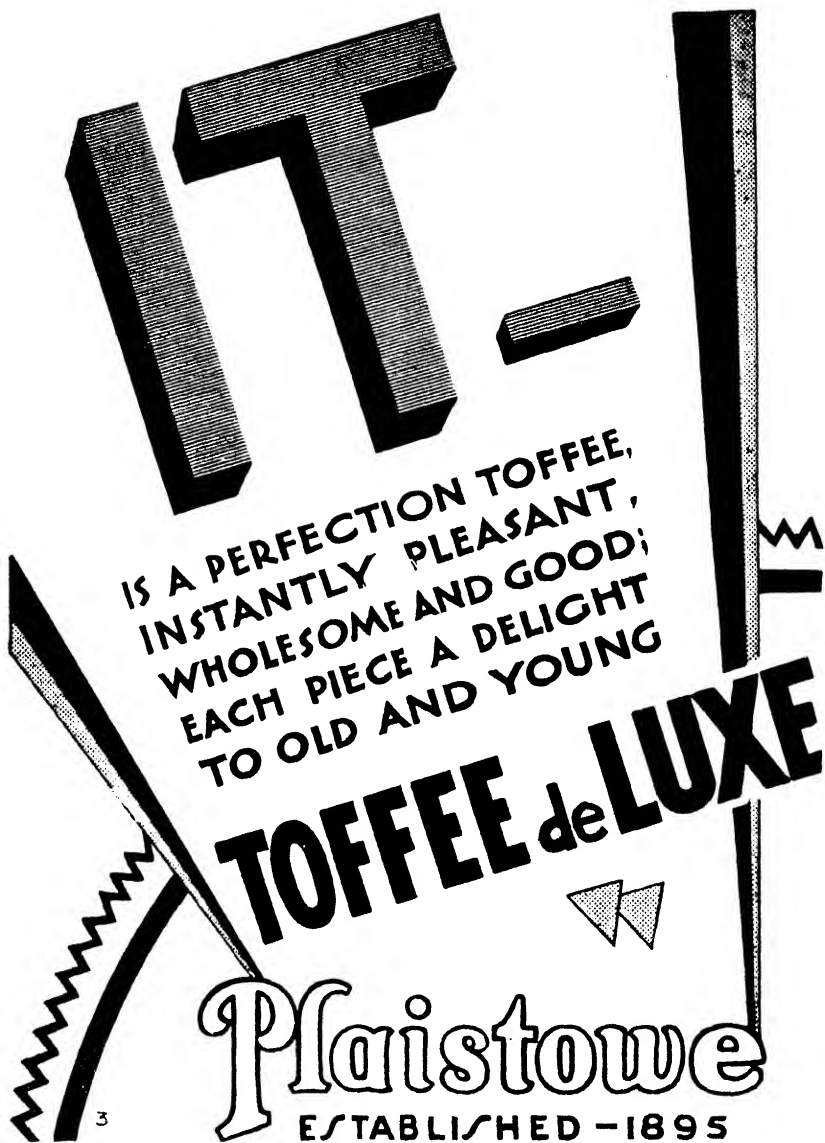
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**CULTIVATION OF THE POTATO IN WESTERN AUSTRALIA.**

(G. N. Lowe, late Senior Potato Inspector.)

The potato, besides being a most important article of diet in practically every civilised country of the world, produces the greatest weight of food per acre. Measured by the bushel, the return from an acre will far exceed that of any of the great cereal crops.

One very important feature of the potato crop is the place which it occupies in a proper system of crop rotation, particularly in lands which have been in cultivation for some years. It must be admitted, however, that this useful function is too often overlooked in this State, and the tendency is to plant land with potatoes year after year with a subsequent depletion of soils and diminution of the return.

**SOILS AND LOCALITY.**

For the production of maximum potato crops, genial weather conditions and a rich, loamy, well-drained soil, together with adequate moisture, are ideal. The potato, however, with proper treatment, will produce satisfactory yields in sand or clay, but due allowances must be made under such conditions. No soil, however rich, is too good for this crop, as it is a heavy feeder.

Generally speaking, the southern coastal areas of this State are the most suited to successful potato production, mainly owing to the assured rainfall and the fact that two distinct crops, the "general" or winter planted crop and the summer planting, are possible. Other localities are restricted to cropping in the season when sufficient moisture is available, namely, in the winter months.

Unless the grower finds it necessary to plant on new land at once, soils left in rough fallow from the previous season will give a considerably greater return, although very often the operations of "breaking up" and potato planting are combined with success. This method is often employed in heavily-timbered land, where partial clearing is adopted, the proceeds of the crop being devoted to the completion of the clearing. However, every opportunity should be availed of to increase the chances of bigger yields by fallowing, and aerating and sweetening

the soil prior to planting. It is hardly reasonable to expect soils which are improperly treated to make adequate returns.

Before the soil is finally decided upon, it is wise to avoid any locality where frost is likely to occur, as a promising crop may be ruined by this agency in the course of a few hours.

In the winter planting, for this reason, a westerly slope should be selected, if possible, as even when the plants are covered with frost, the warming atmosphere will generally disperse it before the direct rays of the sun can strike and bring about sudden thawing which causes the damage.

It may be well, just here, to explain briefly how the damage due to frost-bite on plants is brought about. Much, of course, depends on the stage of growth, as a tender sappy condition is much more susceptible to damage than a hardened woody growth. As the temperature falls to about freezing point, the plant saps are drawn out of the plant cells in the form of pure water, and eventually frozen. Should the thawing be sudden, however, as is the case when the rays of the sun strike directly on the plant, this essential water is not reabsorbed by the plant cells, and death takes place.

The effect is much the same as in a drought-stricken plant or one burnt by the sun, the lack of moisture in each case being the cause of death.

A small garden plot of potatoes or other plants susceptible to frost bite may often be saved from destruction when the frost is noticed on them by watering the plants with ice-cold water, which brings about a gradual thawing.

### DRAINAGE.

Not nearly enough attention is paid to this important question, particularly in the areas of heavy rainfall in the Southern portions of the State. In order to obtain maximum results, drainage must be present naturally, or supplied artificially.

The presence of water in or on the soil exercises a great influence on the growth of the crop. An excess is just as detrimental as a deficiency, and the removal of the excess is known as drainage.

Most land has drainage naturally in some direction, though instances will be found of land which has only a limited degree of drainage, or in which it is lacking, and in land of this nature an improvement is both profitable and necessary to ensure proper cultivation and action of the plant foods.

Too much water in or on the soil has the effect of—

1. Delaying cultivation, particularly in winter and early spring.
2. Making and keeping soil cold because any warmth present goes to the raising of the temperature of the unnecessary water.
3. Excluding the oxygen from between the soil particles, and so delaying the breaking down of organic matter.
4. Preventing a proper depth of root development, for a shallow root development not only restricts the area from which the plant draws its plant foods, but should a dry spell intervene the shallow root system so induced restricts, to that extent, the depth from which the plant may draw moisture.

Proper land drainage then is most necessary in potato soils if anything like adequate returns are to be expected.

Narrow "lands" and deep water furrows kept open and free from obstructions are very effective in ridding overwet soils of their surplus moisture where a proper system of drainage cannot be instituted.

## PREPARATION OF SOIL.

Having decided on the soil and locality, the next operation is the first ploughing, assuming that new or virgin land is to be turned to account. The paddock, of course, will be very rough after this treatment, which should be to a depth of 8 or even 9 inches if the horse power is available. It is advisable to leave the soil in this condition without even harrowing till the following season to allow of the maximum sweetening action of sunlight and air. It is hardly reasonable to expect a full return from land which has lain in an acid condition for centuries under heavy timber, and potatoes respond just as readily to fallow as any other crop.

Deep, thorough ploughing is essential for potatoes, not only from the standpoint of moisture conservation, but for the reason that the potato rootlets have no great penetrative power, and deep cultivation allows of a proper root expansion.



The planting of potatoes on grass land, commonly carried out in the South-West.

Nicely friable soil, deeply worked, drains more readily under wet conditions, and when thoroughly cultivated retains much more moisture should dry conditions intervene. For these reasons, then, deep ploughing should be adopted.

However careful the clearing of the land may have been, a certain percentage of roots and stumps will be found by the plough, and much annoyance and damage to implements will be averted if these are promptly removed. With the object of marking the position of such obstructions a supply of 15-inch long wires, bent over at the top and a piece of white cloth tied in the loop can easily be carried on the plough. As the roots are found the spot may be marked by one of these pegs and the grubbing of them carried out later rather than delay the plough at the time.

The "lands" (*i.e.*, divisions of the paddock by the plough from "finishing furrow" to "finishing furrow") should not exceed 11 yards in the winter crop, and in

a wet locality eight yards will allow of much better drainage and materially assist in the warming up of the soil which is to be sought after at that period.



A good "finish" which allows of surface drainage in the winter months.



Opening of the "crown" ready for planting.

"Lands" wider than half a chain cause waste of time in turning at "head-lands."

Much depends, for the success of the crop, on the methods and thoroughness of cultivation and preparation of the soil, and every effort should be made to bring it to a satisfactory condition.

Because of the variation of soils no hard and fast rule can be laid down as to the means of bringing them to perfection in this direction, but thoroughness is the key to the position. This much is certain that indifferent methods of soil preparation cannot be corrected later by additional fertiliser, nor can the fertilisers have their maximum action if the condition of the soil is not what it should be. Instances often occur of fertilisers being blamed and declared below standard for this very reason.

### SEED—ITS SELECTION AND TREATMENT.

Probably the most important phase of successful potato cultivation is the provision of the very best class of seed, and at the same time this is a feature which generally has too little attention paid to it.

No matter how ideal the conditions of soil, cultivation, fertilising and weather may be, without seed suited to the district and of a proper standard of vitality, it is futile to expect anything like a reasonable return from the crop.

It is astonishing how often anything in the shape of a potato is considered fit for planting, and the old maxim "like begets like" completely forgotten. Inexperienced growers, particularly, are often tempted by high prices to dispose of the very tubers that should be retained for seed, and keeping back for replanting small miserable stuff that could more profitably be turned into pork.

The same growers who are also stock owners would not, of course, apply the principle to the breeding of their animals, but carefully cull the poor ones and retain their best to breed up from.

It is not just pure luck that Melba XV., the world's champion cow, produced 32,522 lbs. of milk and 1,614 lbs. of butter fat during her lactation period, or that the world's champion hen laid 351 eggs in 365 days. Such results are only achieved by systematic and careful selection and breeding, and so with potato culture—the maximum can only be expected where the highest class seed is used.

A very important point to remember in the selection of seed is that the appearance of tubers is of no use when forming an idea of their value from an ultimate cropping standpoint. The degenerate (*virus*) troubles, such as Mosaic, Leaf Roll, etc., are only detectable in the foliage, and a "pretty" line of seed may quite reasonably be heavily infected, with no indication, either external or internal, to proclaim it. Good looking seed is very often only "good looking," and all sorts of care should be exercised in order to ascertain the "strain" and what happened in the way of yield and freedom from disease in the crop from which it came.

This is the very value of the certificate on bags of seed passed into the Certified Seed Scheme by the officers of the Potato Branch. The certificate does not make the seed in the bags one whit better, but it does afford the buyer a reasonable guarantee that seed which bears the certificate is the best obtainable each season, and comes from heavy yielding, disease-free crops.

Points to be remembered in the choice of seed potatoes are first that the variety should be true to name, free from disease both outward and inward; it should come from a heavy-yielding strain, and be suited to the district in which it is to be planted.

Internal disease is usually readily detected when the tubers are cut, and a buyer of seed should exercise this precaution before purchase. Skin diseases are, of course, more easily noticed, but no seed should be accepted showing signs of dis-



case as numerous potato troubles are transmitted to the soil by this means, and such diseases made recurrent in that soil.

In an early district an "early" or quick-growing variety must be chosen to ensure proper maturity in the shorter season. Other things being equal, an early variety is preferable because of the fact that risks such as frost, flooding, and moth infection can often be avoided in the shorter growing period.



An excellent crop of potatoes (19 tons per acre) grown by Mr. Fred. Tonkin--Young's Siding.

Some districts, of course, are limited to winter planting, and growers in such localities are forced to buy supplies of seed each season. In cases of this kind the grower is well advised to make his purchases early and take prompt delivery in order to have the tubers in his own control until planting time arrives. First-class seed is limited in quantity, and so eagerly sought after by experienced men.

Where it is possible a special "stud" plot for seed production should be a first consideration, and instituted for the express purpose of providing tubers of the very highest productive strain from which to supply seed requirements. An area of about a tenth of the whole to be planted is generally adequate, and the potatoes grown in this portion should be from selected roots only.

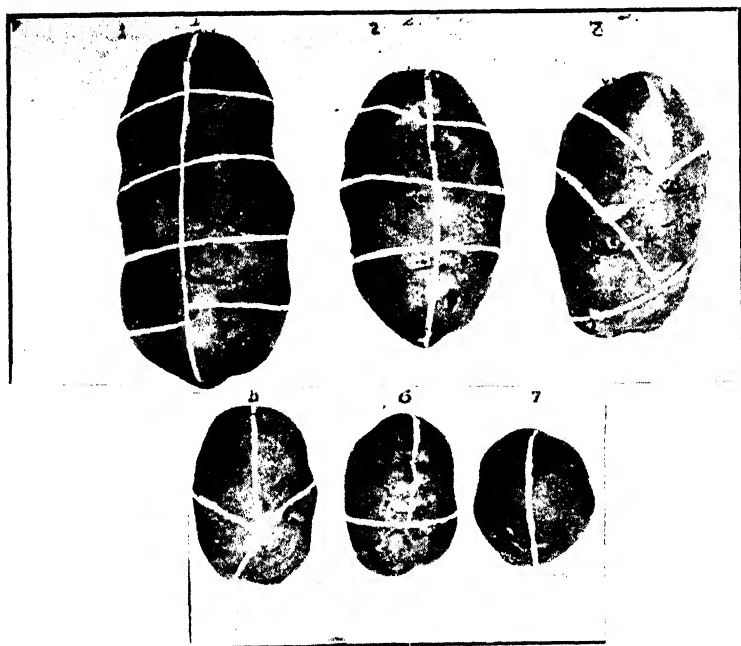
The plot should be isolated and planted quite separately from the commercial crop, and the greater the isolation the more certain will be the results. When the seed plot is well isolated from the main crop it can be subjected more easily to roguing and general inspection. To obtain the best result from such an area during the period of growth it must be given the utmost attention in the matter of eradicating all weakly and abnormal plants. By adopting this method each season, a system of continual selection would be carried out, and the progeny from undesirable seed or diseased tubers would be eliminated, so bringing the seed to

a very high standard. Finally when the crop is dug the grower should aim at a very high standard of, say, not less than 7-9 large, shapely, normal tubers from each plant. This seed should be placed on racks for storage till required for planting the succeeding main crop. In another section of this pamphlet racking will be dealt with more fully.

The most desirable seed is that which has been root selected at digging, and not merely saved because it has come from a very heavy-yielding crop, because even in very heavy crops there is naturally a percentage of plants from which it is not wise to reproduce.

*Mature and Immature Seed.*—Many experiments have been conducted to test the relative values of what is called mature and immature seed. There is very little difference under average conditions as they obtain in our potato-growing areas. Well matured, disease-free tubers, kept under proper conditions, will make good seed and produce satisfactory yields.

*Immature Seed*—that is tubers that have not attained their full growth at digging time—will usually not keep well. Such tubers are subject to bruises, and the skin peels readily, thereby inviting the well-known storage disease of “Black



Methods of cutting seed potatoes.

Spot” or “Storage Trouble” of potatoes. Adverse storage conditions are more apt to injure such seed than seed that is ripe. Further, the question of maturity is only a relative one. It is said that a tuber is ripe when the skin adheres closely, and does not peel in handling. A tuber assumes this character when growth is checked by an attack of Early Blight (the cause of Storage Trouble) or as in the case of our summer plantings when early winter rains set in and arrest the natural maturing of the crop; in consequence a premature ripening is the result in both

instances. One advantage of using immature seed is its comparative freedom from disease, due to the fact that a crop so dug is not exposed so long to disease infection as is one allowed to ripen completely, but mature seed is only less productive when diseases are prevalent. This applies even more strongly in the case of degenerate troubles such as Mosaic, Leaf Roll, etc. Certified seed is more or less an answer, these tubers being selected from fully ripened and matured crops.

Such tubers must be cut at planting from the standpoint of economy, and the following illustration gives a proper idea of how this should be accomplished. One or two eyes are included in the cut portions ("sets") of a weight of two or three ounces, which should be "blocky" in shape rather than thin and narrow.

A simple and effective way of preventing the transmission of disease per medium of the knives when cutting seed is to provide two of these, keeping one steeped in a tin of disinfectant composed of five per cent. formalin and water. When it is noticed that a diseased tuber has been cut into, this should be rejected and the disinfected knife put into use. A very old thin table knife occasionally rubbed up on an oil stone is the best implement, and makes a clean cut not obtained when a thick clumsy knife is operated.

As an indication of the value of the large "set," the result of an experiment in Benger Swamp may be quoted. The trial consisted of varying weights of seed, viz., 1, 2, and 3 ounces in weight, and each experiment was replicated six times—not just one plot of each. Despite the driest season on record and the comparative failure of the swamp crop as a whole, in every plot the 3-ounce seed stood out in both germination, vigor and yield. The 2-ounce came next, and the poorest return was from 1-ounce sets.

Until recently, in this State, in the summer planting it has been almost general to use the small, whole tubers of about hen-egg size saved from the previous crop, due to its giving a better germination in average summer conditions than large seed cut.

This practice is undoubtedly responsible largely for the quick deterioration in yield in districts where followed.

Even when growing from large cut tubers in the winter (which has a tendency to keep up the strain), this care is undoubtedly to a great extent nullified by using small or "round" seed in the succeeding crop. As it is reasonable to suppose that the bulk of large potatoes come from heavy yielding plants, so is it reasonable to suppose that most small ones come from poor yielders or the very type which offers a poor chance of success comparatively.

Fortunately, only quite recently the adaptation of the results of an English experiment now makes it possible to plant large seed cut in the summer planting with germination equal to that of whole seed, so that the necessity for planting small whole seed and so restricting the yield has largely disappeared. To this method the name of the Wet Bag Treatment has been given.

#### WET BAG TREATMENT OF CUT SEED.

This is an adaptation of the result of an experiment conducted at Rothamsted Experiment Station and designed to discover the reason of the rotting of a large percentage of cut seed, whilst a proportion escapes.

After exhaustive tests it was found that where the cut surface of the seed was allowed to heal gradually or callous over in a warm, moist atmosphere, provided in the case of the experiments by cold frames, that a varnish-like substance called

"suberin" formed and provided a protective covering to the inner tissues, thus preventing the ingress of disease which would later cause the rotting of the "set."

The period allowed was from 24 to 48 hours for the treatment, and it was found that the cut seed then gave an equal germination to that of whole tubers and very much in advance of cut seed which was allowed to dry exposed to sun and wind.

It was recognised that this cold frame treatment would not be practicable under local conditions, and it was thought that the desired effect might be achieved for application by growers of this State for the treatment of large quantities of cut seed, if wet bags placed in boxes above and below the cut seed were used. No difficulty as to warm temperatures arises, of course, in this State when the summer crop is being planted in January and February, and the introduction of the wet bags was to provide the moisture necessary.

This treatment was found quite satisfactory as far as the healing over of the cut was concerned and trial plots planted with the treated seed demonstrated that the germination was excellent. Later it was found that merely bagging the seed as cut into wet bags and allowing 48 hours for drying was just as effective, and this preparation for cut seed for summer planting has now become fairly general and indications are that the same treatment applied to seed for winter planting gives a better germination.

The necessity for this in winter is, of course, not nearly as great as in the summer, but as it appears that another 10 per cent. better germination is possible under the wet bag method, this is certainly worth having by such simple means.

A point to remember is that sufficient time must be allowed for the proper callousing of the cut surface of the seed prior to planting, and this is, of course, governed by temperatures in either winter or summer.

"Wet bagging" in the South-Western districts, where very little "sprouting" of seed is followed, can be safely and profitably carried out, but in the Great Southern areas (Albany-Denmark) where sprouted seed is invariably (and rightly) used, a wet bag folded and placed in the bottom of the planting tin or box with another such laid over the top of the receptacle will obviate loss of sprouts such as must occur in subsequent handlings were this class of seed simply cut into wet bags.

### RACKING AND GREENING OF SEED.

Where it is found necessary to hold seed for any length of time, racks, or something similar, will be essential. A great quantity of otherwise good seed is rendered more or less valueless in this State each season by reason of the lack of this facility.

Failing racks, the seed is more often than not simply left standing in the bags sometimes under cover, more often not, until planting, by which time long, tender shoots have developed. Immediately the seed has to be handled these are either knocked off or purposely removed.

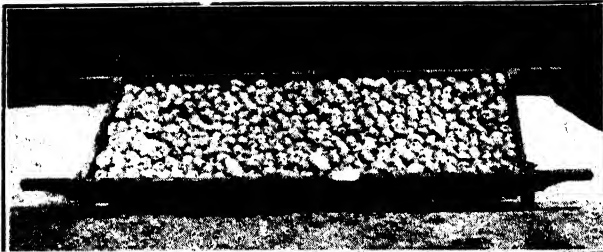
Each time this occurs the vitality and vigour of the tuber are naturally reduced as a certain amount of energy and plant food are drawn from the tubers in the formation of this new growth.

It is essential, therefore, that the original sprouts shall be retained, and racking of seed is quite the best way to accomplish this.

Exposure to the light considerably retards sprouting and hardens the seed by "greening" which is so desirable, where seed has to be held for any lengthy period.

Racking or traying is of decided benefit in that seed so stored is easily and quickly inspected and sorted; in addition the racks may be stacked to greater heights than can bags, with no resultant damage.

Racks as illustrated are readily and cheaply constructed and easily handled. These will hold a bag and a-half, when filled, not being too heavy for stacking to a height. The seed, when racked, should be placed somewhere in the light if "greening" and the checking of the sprouts be desired, but not, of course, actually in the direct rays of the sun. Under the shade of trees or in an open shed where there is a free air circulation is a suitable place for this purpose.



A simple type of seed rack.

Frequent inspections of the seed are necessary, and any tubers showing signs of rotting, "thready eye" or other troubles, should be removed and destroyed.

Where it is wished to induce sprouting a dark warm situation should be chosen where it is still possible to regularly inspect the seed on the racks.



Method of stacking racks.

Even where "greened" seed is used care in handling at all times is necessary, particularly when transferring to the paddock. This can be safely accomplished with sprouted seed where petrol or kerosene tins, with one side removed, are used. The seed is placed into the tins which are so disposed along the "land" to avoid unnecessary waste of time on the part of the planter as he operates. A handle of round timber into each end of which a stout nail is driven is provided, and this should be only sufficiently long to allow of easy transference from tin to tin as required. The nails fit holes driven into the ends of the tin near the upper edge, of course. Handles of stout wire are also used, and should the holes be punched slightly away from the centre of the tin, this will allow of additional room for the hand when filling with seed, and produces a tilting of the receptacle toward the operator when planting.

Seed that is only slightly sprouted may be quite successfully planted from the "koota" or planting bag, which is cut from a cornsack, or the double planting bag as illustrated.



Double planting bag.

#### WIDTH AND DEPTH OF PLANTING.

Naturally much depends on the season of the year at which planting takes place, and due allowances must be made in spacing the "sets," more particularly as to width between rows.

In early winter planting the width between rows can safely be 24 inches, although this spacing does not lend itself to convenient working of the crop by means of the horse cultivators. Later plantings should be made at 27 to 30 inches, according to the possibility of the soil drying out towards the time of maturity.

Summer planted crops are best planted at 30 inches, as moisture is often the limiting factor at this time.

The distance between "sets" should be about 18 inches throughout, except possibly when there is any danger of the soil drying out later, when intervals should be greater.

Generally the correct depth for "sets" is four to five inches, although in early-planted winter crops three inches is more suitable where "moulding" or "drilling up" is followed.

This operation is advisable in winter-planted crops, as it assists drainage and enables the soil to warm up more readily.

Summer-planted crops should be left "flat" to reduce loss of moisture.

Deep ploughing is advisable for at least two reasons, viz., that with the seed planted at the correct depth, should heavy rains be experienced, drainage is afforded, which keeps "sets" away from the accumulating water on the plough bed,

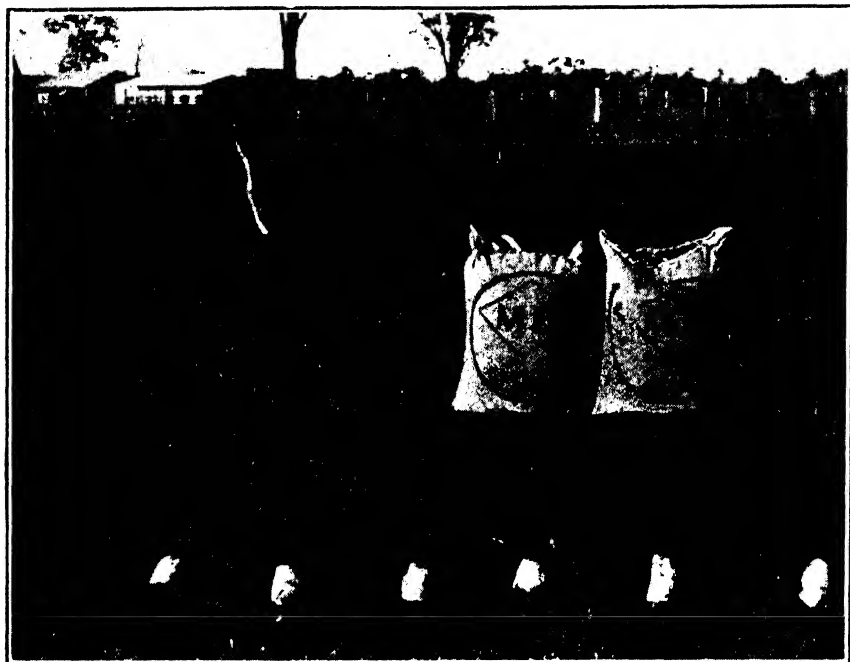


Planting from the double planting bag.

and later should dry conditions supervene, there are several inches of soil below the "sets" worked up to retain the necessary moisture to help carry on the crop to maturity.

Whilst ploughing to the greatest depth possible with the available horse power is distinctly advisable, the depth of planting should not be greater than indicated.

After planting it will be necessary to harrow thoroughly. In the winter planting this may be left with advantage for a week or ten days, provided the ploughing has been thorough and the seed properly covered, in order that the first weed seeds may be checked by the harrow.



Sets planted 4in. from the surface and 3in. up in the sod from the plough bed.

In summer planting rolling and harrowing under general conditions should not be left longer than a day, and a sound practice is to complete each day's work with these operations, so that all moisture possible may be conserved.

WEIGHTS OF SEED REQUIRED TO PLANT AN ACRE OF POTATOES AT DIFFERENT SPACINGS WITH SETS OF VARYING WEIGHT.

Distance between Rows and Sets.	1 oz. Sets.			1½ oz. Sets.			1¾ oz. Sets.			2 oz. Sets.		
	T.	c.	q. lb.	T.	h.	q. lb.	T.	c.	q. lb.	T.	c.	q. lb.
Rows 24in. apart—												
12in. spacing ...	0	12	0 17	0	15	0 21	0	18	0 26	1	1	1 16
14in. ...	0	10	1 7	0	12	3 16	0	15	1 25	0	18	0 7
16in. ...	0	9	0 23	0	11	2 0	0	13	3 7	0	16	0 13
18in. ...	0	8	0 12	0	10	0 15	0	12	0 18	0	14	0 21
Rows 26in. apart—												
12in. spacing ...	0	11	0 5	0	13	3 6	0	16	2 8	0	19	1 9
14in. ...	0	9	1 14	0	11	4 24	0	14	0 7	0	16	7 17
16in. ...	0	8	1 14	0	10	1 24	0	12	2 7	0	14	2 17
18in. ...	0	7	1 13	0	9	0 23	0	11	0 5	0	12	3 15
Rows 28in. apart—												
12in. spacing ...	0	10	1 7	0	12	3 16	0	15	1 25	0	18	0 7
14in. ...	0	8	3 2	0	10	3 23	0	13	0 17	0	15	1 7
16in. ...	0	7	3 7	0	9	3 2	0	11	2 25	0	13	2 20
18in. ...	0	6	3 14	0	8	2 10	0	10	1 7	0	12	0 3
Rows 30in. apart—												
12in. spacing ...	0	9	2 8	0	11	3 24	0	14	1 12	0	16	3 0
14in. ...	0	8	0 14	0	10	0 17	0	12	0 21	0	14	0 24
16in. ...	0	7	1 0	0	8	4 7	0	10	3 14	0	12	2 21
18in. ...	0	6	1 14	0	7	3 26	0	9	2 9	0	11	0 20



### INTERTILLAGE.

A proper working of the crop between the rows is necessary as soon as these are defined, and should be attended to as occasion demands right up to the time when the rootlets of the plants in spreading prohibit this.

In old weedy land it will be necessary to hand hoe along the rows where the horse implements are ineffective.



The improved planting and manure sowing machine being used in Benger Swamp.

### FERTILISERS.

Of the various elements in the soil, necessary for the promotion of plant life, there are usually only three which are not present naturally in sufficient supply for the production of heavy yields.

These are nitrogen, usually supplied artificially by sulphate of ammonia, phosphoric acid supplied in superphosphate and potash, derived artificially as a general thing in this State by the addition of sulphate of potash.

The addition of farmyard manure, whilst highly desirable, is rarely made owing to its scarcity, but this, in conjunction with properly compounded artificials, will give much better results than either separately. Because of the lack of farmyard manure, resort should be made to green manures such as peas and clovers, both of which incidentally will reduce the necessity for the inclusion of so much nitrogen in the artificials, as the legumes have the characteristic of fixing in the soil this element from the atmosphere. Nitrogen is the most expensive portion of potato fertiliser per unit, and green manuring of this description will considerably reduce this side of the fertiliser bill.

A very great factor in the use of heavy green manuring is the benefit to the soil derived mechanically. Organic manures also exert a far-reaching effect on the bacterial and physical properties of soils.

Artificial fertilisers cannot replace organic manures completely, as the latter have a much wider function and probably these uses are not paid sufficient attention by the average potato grower in this State.

In the South-West portion of this State, at least, more growers are finding out by actual experience the benefit which accrues by ploughing under green subterranean clover at intervals of three or four years as the pastures need renewing.

Both crops benefit immensely, the potato at once and the clover in the ensuing seasons.

*Nitrogen* promotes the vegetative growth of plants, and the effect is noticeable in luxuriance of leaf and green colouring. An excess will produce superabundance of "top" in potatoes, with a darker green than usual, and maturity is considerably delayed, whilst a deficiency results in a general stunting of the plant, accompanied by a yellowness of the leaves.

Sulphate of ammonia is the most common source of nitrogen, both as a furrow application and as a top dressing. Nitrate of soda, another source, has not been found at all successful in the furrow, but can be used as a top dressing where an immediate effect is desirable. Early winter crops respond most profitably to a top dressing of two cwts. per acre of sulphate of ammonia just as the crop is showing in rows. Care must be exercised, however, in not allowing the chemical to come into direct contact with the plant, as otherwise burning will result.

Experience goes to show, more particularly of course where backward seed is used in the winter planting, that the bulk of the nitrogen applied in the furrow as sulphate of ammonia has leached out before the plants can put it to profitable use, and because of this a sound procedure for this particular planting is to apply nearly all the sulphate of ammonia as a top dressing, and so derive the maximum benefit from it by this means. The condition of the seed, however, must govern this.

*Phosphates*.—These are in poor supply in our soils, and the deficiency must be made up by applying some form of phosphatic manure. Bonedust or bone flour was at one time largely used, but this has now been superseded by superphosphate which is generally accepted as being more suitable, supplying to the crop phosphoric acid, the greater proportion of which is water soluble, and therefore more readily available to the plant. Moreover, the plant food so provided is considerably cheaper based on unit values than when bought in other forms.

Basic slag is not suitable for inclusion in a potato fertiliser, as the phosphates so contained are not in a form readily available for potatoes.

The functions ascribed to phosphates are:—The stimulation of the root system and the hastening of ripening of the plant to maturity.

Up to the present, from experimental work, it appears that in all soils tried out to potatoes in this State, the application of superphosphate in far heavier dressings than in other parts of the world, or even in other States of Australia, is desirable and profitable.

*Potash*.—The importance of this plant food for potatoes can be readily understood when it is recognised that one of its chief functions is the elaboration of starch. The starch content of a potato largely constitutes its food value, hence the necessity of the inclusion of potash in the potato fertiliser, where cooking qualities are concerned.

Whilst potash reduces to an extent the green colouring matter or chlorophyll in the leaves, it nevertheless materially assists in the function of assimilation, and is very valuable for this reason alone. In some potato-growing districts in this State, particularly the South-Western division, the growers have neglected to supply potash in their fertiliser application for a number of years, but now find it increasingly necessary as a consequence. In the Great Southern district, more particularly in the peat swamps, the provision of potash is a prime necessity, though the nitrogen dressing for such soils can quite easily be overdone, because of the high content of this plant food naturally available in such soils.

Potash also has the effect of delaying maturity, in opposition to that displayed by phosphates of hastening maturity. In some soils in Western Australia the use of potash has a most marked effect in the increase in yield; in others this is not nearly so sharply defined, but in all cases where potash is applied, an increase of starch is shown on analysis.

Lack of potash is quite plainly shown in a potato crop by a distinct coppery tinge in the foliage, and an unusually early death of the plants.

Potash for potatoes may be regarded as an absolute essential, not only in peat soils, but in sand and soils which are gravelly in composition. Even in heavy loams and clays, which may generally be regarded as containing a fair quantity of natural potash—this ingredient of the plants' requirement is necessary, and should be provided by the grower, for the reason that the potash naturally present may not be sufficiently available.

Sulphate of potash is generally regarded as producing a drier and better quality tuber than muriate or other lower grade potash salts, though nothing definite locally has been proved in this direction.

*The constitution and applications of fertiliser.*—First and foremost it must be remembered that lack of drainage and faulty or insufficient preparation and cultivation of potato soils cannot be rectified by the composition or heavier application in the manurial system.

Fertilising is dependent very largely on climatic and soil conditions, and each grower must adjust his mixture and application to cover these.

For this reason it is not possible to lay down a hard and fast system of fertilising for all classes of soil in different districts.

A very successful mixture in good loams, and applied at the rate of 16 cwt. per acre, is:—Superphosphate, 15 parts; sulphate of ammonia, 5 parts; sulphate of potash, 5 parts.

Peat soils, being high in natural nitrogen, require less of this, so that the sulphate of ammonia should be reduced and an addition of sulphate of potash made.

The following mixture will be more suitable for peat soils:—Superphosphate, 15 parts; sulphate of ammonia, 3 parts; sulphate of potash, 8 parts; applied in the furrow at the rate of 16 cwt. per acre. Hand sowing of fertilisers still remains a general practice in Western Australia, although the modern planting machine does the job well where intelligently used.

In the application of chemical fertilisers proper care must be exercised to avoid direct contact with the seed, particularly the cut surface. Recent experiments show most conclusively that an appreciable loss, up to 15 per cent. in germination alone, occurs when this important detail is not observed. A lack of vigour during growth is also plainly noticeable, and consequently a decreased yield follows.

The seed should be gently pressed into the "mould" of the soil just turned, so that no direct contact may occur. This, of course, entails a little extra time compared with the haphazard practice, so often noticed, of dropping the set anywhere, but is distinctly worth while.

The fertiliser should be applied evenly and uniformly so that every plant receives an equal quantity. A wide-mouthed 3-gallon bucket is desirable for purposes of fertiliser distribution, and is much more convenient than the ubiquitous kerosene tin converted for this purpose.

### HARVESTING.

The ripening of the tubers is denoted by a general and normal yellowing of the foliage and subsequent drying off of the tops, but harvesting is often regulated by market prices. While root-selected seed may be lifted before this stage has been reached, if the tubers are intended for storage for a period they must be properly mature—this being ascertained by the skin being set.

Hand-digging is still the most popular form of lifting the crop in this State, but the machine digger gives satisfaction when conditions are suitable, and greatly reduces this heavy item in the cost of cropping.

### GRADING.

It will be found far more satisfactory to pick up the tubers at digging without attempting to grade in the field, and later make a separate operation of this. Should the crop not be thoroughly ripe, however, grading in the paddock must be resorted to, and too much handling avoided.

A "screen" or grader reduces the time, and makes for efficiency. This is in the form of a sloping table with side-boards and slatted floor constructed to any convenient size, the bags being suspended in front and sides as needed.

It is not generally realised how important correct grading is and what an influence this has on returns, or closer attention would be given to it by growers.

### STORAGE.

Storage, to be successful, depends upon temperature, aeration, soundness of the tubers and moisture, particularly freedom from Potato Moth infection. Layers of tubers of not more than three feet in depth covered by straw, and where conditions are otherwise suitable, stacking reasonably high in bags in an airy, well-ventilated shed, are sufficient in the cooler areas of the State. Cool storage at about 40 degrees F. is perfectly satisfactory, but too costly under the present conditions. Any device which tends to reduce temperature during our hotter months adds to the success of storage. The practice of "pitting" or "clamping" cannot safely be practised in Western Australia, and the necessity for it does not arise during the winter.

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### ERRATUM.

In the December issue of the *Journal of Agriculture* there occurs a typographical error in the Horticultural Notes, wherein the writer (the Superintendent of Horticulture) is reported to have anticipated, prior to the advent of thrip, that the apple crop for the year would be 2,250,000 bushels. This should read 1,250,000 bushels, and the error makes it appear that the damage done by the thrip is much greater than is actually the case.—Ed.

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## **"THE JOURNAL OF AGRICULTURE"**

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## **THE "ROYAL" AND DISTRICT AGRICULTURAL SOCIETIES' 50-ACRE CROP COMPETITIONS, 1930.**

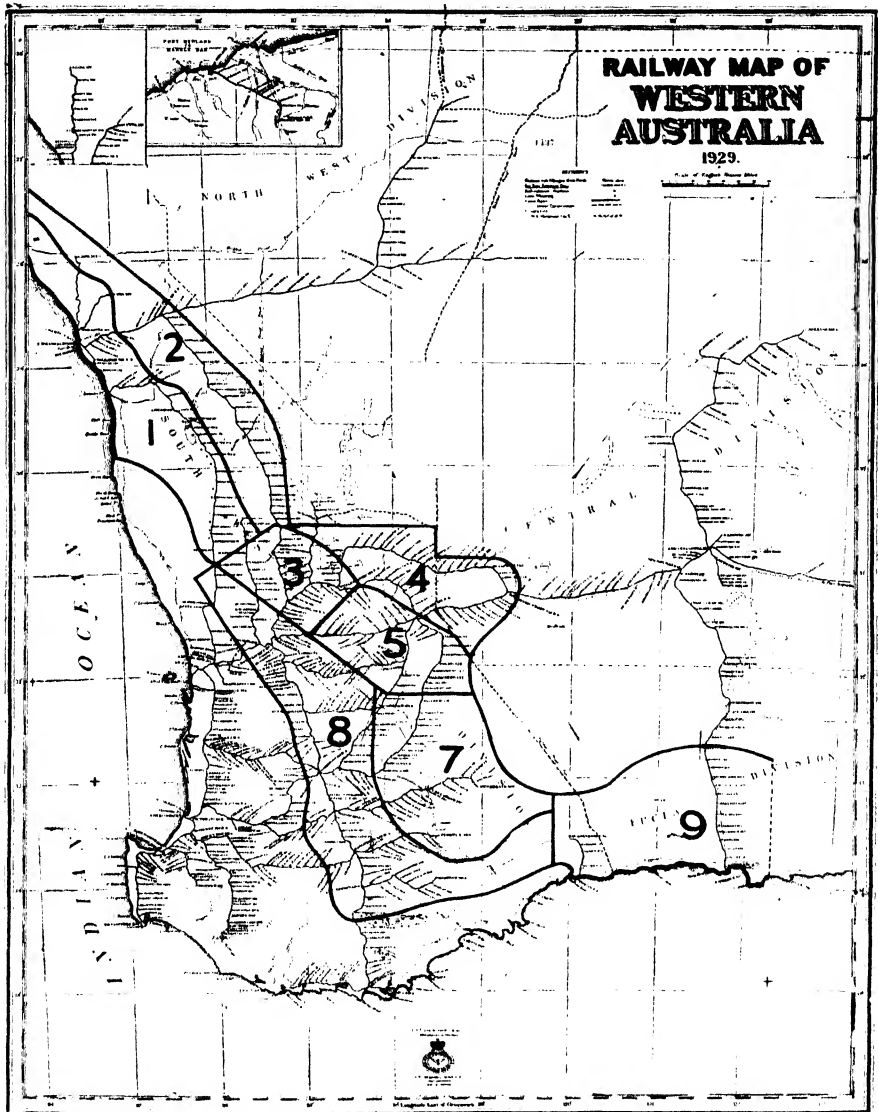
I. THOMAS,

Superintendent of Wheat Farms.

Ten years ago the first Royal Crop Competition in this State was conducted. Starting in a small way, with fifteen entries, the crop competitions have grown in importance and improved in technique, until to-day they occupy no mean part in the life of the agricultural community. In the earlier competitions the entries were received direct by the Royal Agricultural Society, but in 1923 affiliated District Agricultural Societies were encouraged to conduct district crop competitions, and the first and second prize winners of each district competition competed for the Zone Championships. This effected a very considerable improvement in the number of entries. Farmers living in localities where no district competition was being conducted were not debarred from competing, as they were permitted to make their entry direct with the Royal Agricultural Society.

As can be readily understood, there is a considerable variation in rainfall, soil, etc., in a wheat belt so widely scattered, extending, as it does, from Ajana in the North to Scaddan in the South-East. A subdivision has therefore been made, and the wheat belt divided into eight zones, in such a manner that districts having similar interests and climatic conditions have been grouped together. This division was made in 1925 and has remained unchanged, excepting for a few alterations, the most important of which were the creation of a new zone, No. 9, in 1929, to embrace the Ravensthorpe and Esperance areas, and the elimination of No. 6, which was absorbed into No. 8. This division of the wheat belt has the

added advantage of making it possible for the one judge to inspect all the competing crops in the one zone. The accompanying map shows the eight zones referred to.



In each of these zones a championship prize of £10 and a second prize of £2 10s. are awarded. The competitors eligible for these awards are the first and second prize winners of the competitions held by the affiliated district Agricultural Societies, and those competitors who have entered direct with the Royal Agricultural Society, because of no district competition being conducted in their own district.

In addition to these zone prizes the Royal Agricultural Society each year offers a special prize of £5 5s. to the competitor in any zone obtaining the highest calculated bushel yield per acre. This prize was first offered in 1925.

The conditions of the competitions require that the crop shall be grown on fallowed land, shall not be less than 50 acres in area, of one variety, and shall be judged under the following scale of points:—

Yield	..	..	..	..	50 points
Freedom from weeds	..	..	..	..	10 „
Freedom from disease	..	..	..	..	10 „
Freedom from admixture	..	..	..	..	15 „
Evenness of growth	..	..	..	..	15 „
					—
Total	..	..	..	..	100 „
					—

The system adopted has been to allot one point for each calculated bushel yield, which is determined not by estimation, but upon that calculated from portions of the crop obtained from small areas taken systematically throughout the crop. These samples are then threshed and the grain weighed.

As an indication of the improvement in yields, brought about by these competitions, it is interesting to note the alteration to the scale of points for yield, rendered necessary by the increased yields of the leading competitors, as is illustrated in the following table:—

Year.				Scale of Points for Yield.	Highest bushel yield in Competition.
					bus.
1921	...	...	...	30	...
1922	...	...	...	30	...
1923	...	...	...	35	40
1924	...	...	...	35	36
1925	...	...	...	40	36
1926	...	...	...	40	38
1927	...	...	...	40	40
1928	...	...	...	40	40
1929	...	...	...	50	46
1930	...	...	...	50	43

Since the inception of the Royal and District Crop Competitions, the judges have been departmental officers attached to the Wheat Branch of the Department of Agriculture.

The awards and judges' reports, together with a detailed analysis of the cultural details of all competitors, have been prepared and will be found in the following pages:—

### ZONE 1.

Judge—I. THOMAS, Superintendent of Wheat Farms.

Royal Society—6 Competitors.

Three Springs Society—3 Competitors.

Total—9 Competitors.

### THREE SPRINGS AGRICULTURAL SOCIETY.

Three crops were submitted for inspection in the competition conducted by the Three Springs Agricultural Society, two of the variety Nabawa, and the other Merredin.

The rainfall for Three Springs was as follows:—

—	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Three Springs ...	...	...	22	76	106	541	288	110	80	103	1,228	5	21	1,352

The awards made are as follows:—

### THREE SPRINGS AGRICULTURAL SOCIETY.

Judge: I. Thomas, Superintendent of Wheat Farms.

Competitor.	Address.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Total, 100 points.
Hebiton, J. K. ...	Three Springs	Nabawa ...	31	8	8	12	13	72
McKenzie, N. ...	do. ...	Merredin ...	27	9	8	13	13	70
Franklin, W. E. ...	do. ...	Nabawa ...	27	7	8	14	13	69

The winner's crop (Mr. J. K. Hebiton, sen.), of the variety Nabawa, was part of 80 acres of the same variety. It had been planted with a combined cultivator drill during the last week in April with 50 lbs. of re-cleaned seed which had not been treated for the prevention of the disease Ball Smut. Superphosphate was applied at 112 lbs. per acre. It was somewhat irregular in height and stooling and traces of the disease Ball Smut were noticed. Stray plants of barley and another variety were present. It gave promise of yielding well.

From an area of 160 acres of the variety Merredin, 50 acres were submitted by Mr. N. McKenzie, and this entry was awarded second prize. It was even in height, but somewhat irregular in stooling. It had been planted during the second week in May with 45 lbs. of graded pickled seed with 90 lbs. of superphosphate per acre. Traces of the disease Take-all and Flag Smut were noticed, as were also isolated plants of barley.



The cultural details of the methods employed by the different competitors are tabulated hereunder:—

# CULTURAL DETAILS.

Competitor.	No. of years cropped.	Timber.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Hobiton, J. K., Jun	5th 2nd on fallow	York gum, salmon gum	Aug. and Sept.	Disc cultivating	3-4 in.	Good	Springtype cultivated Oct., Nov. and Jan. Planted with a combined cultivator drill.	Xabawa	Last week April	50	112	No	Re cleared	Slight trace of Ball. Smut and Septoria
McKenzie, N.	4 crops 3 fallows	York gum, mallee and scrub	July	Disc cultivating	3½ in.	Good	Rigid type cultivated May. Planted with combined cultivator drill	Merredin	2nd week May	45	90	Copper carbonate	Yes	Traces all; Flag Smut and Loose Smut
Franklin, E. W.	1st crop after fallow and 6 years pasture	Salmon and morrell	July	Mould-board	5 in.	Good	Cross ploughed 4in. deep in September, part with mould-board, part with disc. Springtype cultivated prior to seeding.	Xabawa	3rd week April	60	90	Copper carbonate	Yes	A little Take all Septoria

## ROYAL AGRICULTURAL SOCIETY—ZONE 1.

In previous years no district Agricultural Society in this Zone provided for crop competitions. This year, however, in addition to those competitors nominating direct with the Royal Agricultural Society, the Three Springs District Agricultural Society conducted a local 50-acre Crop Competition, the winners of which were eligible and automatically became competitors for the Royal Agricultural Society's Zone prizes.

The rainfall recorded during the year for centres where the competing crops were grown was as follows:—

	Growing Period.											Total for year.
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Total.	
Coorow ...	...	...	118	165	53	628	326	157	94	101	1,359	1,655
Three Springs ...	...	...	22	76	106	541	288	110	80	103	1,228	1,352
Moora ...	...	...	217	128	107	567	365	282	158	129	1,608	1,979
Carnamah ...	...	...	87	31	73	731	325	153	95	138	1,515	1,642

The awards made are as follow:—

## ROYAL AGRICULTURAL SOCIETY ZONE 1.

Judge: L. Thomas, Superintendent of Wheat Farms.

Competitor.	Address.	Society.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Total. 100 points
Bothe, B. D....	Coorow ...	Royal ...	Nabawa ...	35	8	8	11	13	78
Morcombe, P. T.	do. ...	do. ...	Felix ...	32	9	8	12	13	74
Hebiton, J. H.	Three Springs	Three Springs	Nabawa...	31	8	8	12	13	72
Roberts, J. A.	Moora ...	Royal ...	Nizam ...	32	7	8	13	13	71
McKenzie, N.	Three Springs	Three Springs	Merredin	27	9	8	13	13	70
Forrester, J. K.	Carnamah	Royal ...	do. ...	29	7	8	13	12	69
Gunning, A. S.	do. ...	do. ...	Nabawa...	25	7	8	11	11	62
Hopkinson, H. J.	Milling ...	do. ...	do. ...	16	9	9	13	10	57

The competing area of the winner, Mr. B. D. Bothe, of Coorow, was part of 80 acres of the variety Nabawa. It had been planted with a combined cultivator drill with harrows attached during the first week of May, with 55 lbs. of graded seed, together with 180 lbs. of superphosphate per acre. Sheep were depastured on it about the middle of June, which apparently had not checked its growth to any extent. At the time of inspection, despite its tall growth and slight bleaching of the straw, it had the appearance of a high yielding crop. It was fairly free from admixture and weed growth. Small isolated patches of the disease Take-all were noticed.

The 50 acres of the variety Felix, submitted by Mr. P. T. Morcombe, also of Coorow, was part of 80 acres of the same variety, and was awarded 2nd prize. It was of a nice even stripping height, and with the exception of scattered mustard plants, was fairly free of weeds. Stray plants of barley and traces of the disease Flag Smut and Rust were noticed. It had been planted during the second week in May with 60 lbs. of graded seed per acre with an application of 120 lbs. of superphosphate.

The cultural details relating to the competitors' crops in this competition are as follow:—

## CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Bothe, B. D.	9th crop	Salmon and york gum	July	Mould-board	in. 4	Good	Fed off with sheep till mid June. Disc cultivated Aug. Spring-tyne cultivated Sept. Disc cultivated before seeding. Planted with combined cultivator drill	Nabawa	1st week May	55	180	Copper carbonate	Yes	Trace Takeall
Morcombe, P. T.	6th crop 2nd on fallow	Salmon and gumlet	June	Disc cultivating	4	Good	Grazed with sheep at all times. Skim ploughed September. Springtyne cultivated March. Harrowed end April. Planted with combined cultivator drill	Felix	2nd week May	60	120	Copper carbonate	Yes	Traces Rust and Flag Smut
Hobson, K., Junr.	5th crop 2nd on fallow	York gum and salmon gum	Aug. and Sept.	Disc	3-4	Good	Springtyne cultivated Oct. Nov. and Jan. Planted with combined cultivator drill	Nabawa	Last week April	50	112	No	Re-cleaned	Slight traces Ball Smut and Septoria
Roberts, J. A.	2nd crop both on fallow	Salmon gum	June	Mould-board	3-3½	Good	...	Nizam	1st week May	36	112	Copper carbonate	Yes	Traces Flag and Loose Smuts
McKenzie, N.	4 crops 3 fallows	York gum, mallee and scrub	July	Disc cultivating	3½	Good	Rigid tyne cultivated May. Planted with combined cultivator with harrows attached	Merredin	2nd week May	45	90	Copper carbonate	Yes	Traces Takeall, Flag Smut, and Loose Smut
Forrester, J. K.	6th crop 4th year on fallow	York gum (heavy)	June	Disc	3½	Good	Springtyne cultivated Sept. and Oct. Planted with combined cultivator drill	Merredin	Last week May	45	100	Copper carbonate	Yes	Traces Ball and Flag Smut and Septoria
Young, A. S.	Cropped at least 6 years	Salmon, gumlet and tea-tree	June	Disc	3½	Good	Skim ploughed Aug. Harrowed Sept. Planted with a sun-dry seeder and harrowed immediately after	Nabawa	2nd week April	60	150	Copper carbonate	Re-cleaned	Traces Ball Smut, Takeall and Septoria
Jopkinson, H. J.	1st crop	Jam, wattle and tamma	July	Disc	5	Fairly good	Disc cultivated early March prior to seeding	Nabawa	Last week April	45	100	Copper carbonate	Yes	Slight traces Takeall, Rust and Septoria

## ZONE 2.

Judge—F. L. SHIER, B.Sc. (Agric.), Agricultural Adviser.

Royal Society—1 Competitor.

Dalwallinu Society—9 Competitors.

Total—10 Competitors.

## DALWALLINU AGRICULTURAL SOCIETY.

Nine crops were inspected in the competition conducted by the Dalwallinu Agricultural Society.

The rainfall for stations nearest the competitors was as follows:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Dalwallinu ...	...	...	232	118	52	429	232	175	96	106	1,090	2	176	1,618
Ballidu ...	...	...	112	158	64	545	230	187	93	64	1,183	3	48	1,504
Kalannie ...	...	...	194	158	85	449	168	168	84	74	1,028	...	40	1,420

The awards were as hereunder:—

## DALWALLINU AGRICULTURAL SOCIETY.

Judge: F. L. Shier, B.Sc. (Agric.), Agricultural Adviser

Competitor.	District.	Variety.	Yield, 50 pts	Free- dom from weeds, 10 pts.	Free- dom from Dis- ease, 10 pts.	Free- dom from admix- ture, 15 pts.	Even- ness of growth, 15 pts.	Total, 100 pts.
Sutcliffe, J. G. ...	Damboring ...	Glueclub ...	33	8	9	12	14	76
Butcher, A. J. ...	Pithara ...	Glueclub ...	32	9	9	12	13	75
Locke, F. C. ...	Dalwallinu ...	Merredin ...	30	8	9	14	13	74
Bradford Bros. ...	Damboring ...	Gluyas Early ...	29	9	8	14	14	74
Martin, K. J. ...	Dalwallinu ...	Ford ...	30	8	8	13	13	72
Georgey, C. H. ...	Kalannie ...	Nabawa ...	26	9	9	13	13	70
Reilby, J. ...	Ballidu ...	Gluyas Early ...	26	9	9	13	12	69
Browning, G. W. ...	Pithara ...	Gresley ...	26	9	9	10	13	67
Whittingham, A. G. & A. J.	Pithara ...	Canberra ...	26	8	7	12	13	66

The first prize winner, Mr. J. G. Sutcliffe's entry of Glueclub, was estimated to yield 33 bushels per acre. It was fairly free from weeds, well headed and even, but contained a few strange heads.

The second prize was secured by Mr. A. J. Butcher's entry, also of Glueclub. It was well headed, fairly free from weeds, but contained a trace of Take-all. It was estimated to yield 32 bushels per acre.

Below is a table showing the cultural details adopted by the various competitors:—

CULTURAL DETAILS.

Competitor.	No. of Years cropped.	Timber.	When ploughed	Implement	Depth.	Subsequent cultivation.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Ucliffe, J. G.	15	Salmon, gimlet and morrel	June	Disc	in. 3½	Springtyme cultivated Sept. and October	Glueclub	End April ...	38	90	Copper carbamate	Yes	
Utcher, A. J.	7-8	Salmon, gimlet and morrel	July-Aug.	Disc	3½	Springtyme cultivated Sept. and again March	Glueclub	End April ...	45	112	Copper carbamate	Yes	Patches of Takeall
Locke, F. C. ...	17	Salmon and gimlet	June	Mould-board	4	Springtyme cultivated Aug. and Sept.; harrowed Oct.; springtyme cultivated before drill	Morredlin	End April fed off	45	112	Copper carbamate	Yes	Takeall
Radford Bros.	7	Salmon, gimlet and morrel	June-July	Mould-board Disc	4	Springtyme cultivated Sept. and again summer. Planted with combined cultivator drill	Gluyas Early	Mid-May ...	50-55	90	Copper carbamate	Yes	Trace Flag Smut
Martin, K. J.	8-10	Salmon and morrel	July	Mould-board	3½	Springtyme cultivated and rolled end September	Ford	End April ...	50	80	Copper carbamate	Yes	Takeall
Morgey, C. H.	3	Salmon and morrel	July	Disc	3½	Sundercut February ...	Nabawa	Beginning April	45	90	Copper carbamate	Yes	
Elby, J. ...	4-5	Gimlet and morrel	July	Disc	3½	Springtyme cultivated twice prior drilling	Gluyas Early	Early May ...	60	112	Copper carbamate	Yes	
Rowning, G. W.	Unknown	Salmon and gimlet	July	Disc	3½	Springtyme cultivated Sept. and before seeding	Gresley	Mid-April ...	50	80	Copper carbamate	Yes	
Hittingham, A. G. & A. J.	4	Morrel and gimlet	July	Disc	2½	Springtyme cultivated Sept. and before seeding	Camberra	1st week May...	55	90	Copper carbamate	Yes	Trace Flag Smut

## ROYAL AGRICULTURAL SOCIETY—ZONE 2.

The competitors in this competition include an entry made direct with the Royal Agricultural Society and the first and second prize winners in the Dalwallinu Agricultural Society's crop competition. The awards were as hereunder:—

## ROYAL AGRICULTURAL SOCIETY—ZONE 2.

Judge: F. L. Shier, B.Sc., Agric., Agricultural Adviser.

Competitor.	District.	Society.	Variety.	Yield, 50 pts.	Free- dom from weeds, 10 pts.	Free- dom from Dis- ease, 10 pts.	Free- dom from ad- mix- ture, 15 pts.	Even- ness of growth, 15 pts.	Total 100 pts.
Sutcliffe, J. G.	Damboring...	Dalwallinu ...	Gluehub	33	8	9	12	14	76
Butcher, A. F.	Pithara ...	Dalwallinu ...	Gluehub	32	9	9	12	13	75
Porter, F. A. ...	Ajana ...	Royal ...	Nabawa	18	9	9	13	14	63

The winner of this competition also won the Dalwallinu competition.

The rainfall for Ajana and Dalwallinu is shown in the following table:—

---	Jan	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July	Aug.	Sep.	Oct.	Total.			
Ajana ...	...	...	51	90	99	653	208	150	68	67	1,245	9	10	1,405
Dalwallinu ...	...	...	232	118	52	429	232	175	96	106	1,090	2	176	1,618

The cultural details are summarised hereunder:—

CULTURAL DETAILS.

Competitor.	No. of years cropped.	Timber.	When ploughed	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Sutcliffe, J. G.	15	Salmon, gim-let and morrel	June	Disc	in, 34	Springtyme cultivated Sept. and October	Glucub	End April ...	38	90	Copper carbonate	Yes	
Butcher, A. J.	7-8	Salmon, gim-let and morrel	July-Aug.	Disc	34	Springtyme cultivated Sept. and again March	Glucub	End April ...	45	112	Copper carbonate	Yes	Patches of Takeall
Porter, F. A....	1st fallow	York gum	July	Disc	3	Disc cultivated during February	Nabawa	End April ...	50	112	Copper carbonate	Re-cleaned	

## ZONE 3.

Judge—A. S. WILD, B.Sc.(Agric.), Agricultural Adviser.

Royal Society—1 competitor.

Wongan Hills Society—

Light land—6 competitors.

Heavy land—5 competitors.

Dowerin Society—10 competitors.

Wyalkatchem Society—9 competitors.

Total—31 competitors.

## WONGAN HILLS AGRICULTURAL SOCIETY.

The Wongan Hills Agricultural Society conducted their 50-acre crop competition in two sections, for heavy and light land respectively—the classification of the competitors being made by the Society. It is pleasing to note that there were no withdrawals from either section, all entries being submitted for inspection.

The awards made in both sections are as follow:—

## WONGAN HILLS AGRICULTURAL SOCIETY.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

## HEAVY LAND.

Competitor.	District.	Variety.	Yield, 50 pts.	Free- dom from weeds, 10 pts.	Free- dom from Dis- ease, 10 pts.	Free- dom from admix- ture, 15 pts.	Even- ness of growth, 15 pts.	Total 100 pts.
Mt. Rupert Co. ...	Wongan Hills	Merredin ...	35	9	8	13	14	79
Lane Bros. ...	do. ...	Ford ...	32	9	9	14	13	77
Ackland, J. H. ...	do. ...	Nabawa ...	31	9	8	14	13	75
McPharlin, G. A. ...	do. ...	Daphne ...	29	9	9	14	13	74
Fowler, G. F. ...	do. ...	Baroota Wonder	32	8	8	12	12	72
Robinson, J. & Sons	do. ...	Gresley ...	28	8	8	13	13	70

## LIGHT LAND.

Competitor.	District.	Variety.	Yield 50 pts.	Free- dom from weeds, 10 pts.	Free- dom from Dis- ease, 10 pts.	Free- dom from Admix- ture, 15 pts.	Even- ness of growth, 15 pts.	Total 100 pts.
Glenvor Pastoral Co.	Wongan Hills	Nabawa ...	32	9	9	14	14	78
Millsteed, W. H.	do. ...	Nabawa ...	26	9	9	14	13	71
Roberts, I. B. ...	do. ...	Nabawa ...	25	9	9	13	13	69
Robinson, J. & Sons	do. ...	Glueclub ...	23	9	9	13	13	67
Millsteed Bros.	do. ...	Doller ...	21	9	8	13	13	64



In the heavy land section the Mt. Rupert Co.'s crop of the early variety Merredin secured first place, with a total of 79 points, the calculated yield being 35 bushels. This crop was grown on country which originally carried salmon, morrel and gimlet timber. The land had been ploughed to a depth of 4 inches with a mouldboard plough early in September. As would be expected, the condition of the land at this time was somewhat hard. In the same month the land was harrowed and then springtyne cultivated. The harrowing was repeated in early November after rain and the springtyne-cultivation in early May. Subsequently the crop was planted with a combined cultivator-drill and harrowed immediately after. The seed was applied at the rate of 60 lbs. and the superphosphate at 80 lbs. per acre.

The light land section showed some very fine crops for this class of country. The Glenvar Pastoral Co.'s crop of Nabawa, calculated to yield 32 bushels per acre, was a very attractive one, being very free of weeds, disease or admixture, and even in growth. It had been planted at the end of April, at the rate of 48 lbs. of graded seed, with 150 lbs. of superphosphate per acre. The land, which was scrub-plain, had been ploughed with a disc plough to a depth of 4 inches during July of the previous year. It had been left in an open state until just before seeding, when it was disced to a depth of 2½ inches.

These cultivations are typical of those employed by all the competitors in this light land section of the competition.

The monthly rainfalls recorded at Wongan Hills throughout the year are shown hereunder:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Wongan Hills	...	...	95	117	92	477	275	192	66	57	1,159	...	153	1,524

The cultural details of the crops competing in both the heavy and light land sections set out in the following tables:—

## CULTURAL DETAILS.

*Heavy Land.*

Competitor.	No. years cropped.	Timber.	when ploughed.	Condition of land.	Implement.	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of sowing.	Rate of sowing.	Seed treatment.	Grassland.	Disease.
Rupert Co.	Old land	Salmon, morrell and gimlet	Early Sept.	Hard	Mould-board	4 in.	Harrowed and spring-type cultivated early Sept. Springtype cultivated early May. Planted with combined cultivator drill and harrowed	Merrellin	End May	60	80	Copper carbonate	Yes	Trace Smut
de Bros. ...	6	Salmon and gimlet	Aug.	Good	Mould-board	4	Harrowed 1 Aug. Spring-type cultivated Sept. and April. Planted with combined cultivator drill and harrowed	Ford	Mid May	60	120	Copper carbonate	Yes	Traces all
land, J. H.	4	Salmon and gimlet, and portion morrell	June	Good	Mould-board	4	Springtype cultivated Sept., and prior to sowing. Planted with combined cultivator drill	Natawa	Mid May	50	120	Copper carbonate	Yes	Trace all
Charlin, I. A.	3	Chiefly salmon	Late Sept.	Hard	Disc	2½-3	Springtype cultivated end Oct. and harrowed just after. Planted with combined cultivator drill with light harrows attached	Daphne	Mid April	45	90	Copper carbonate	Yes	Trace Takeall
Mrs. G. F.	Old land	Salmon and gimlet	July	Fair	Mould-board	4	Planted with combined cultivator drill with light harrows attached	Barocra Wonder	Mid April	50	90	Copper carbonate	Yes	Takeall
Denson, J. & Sons	Half old land, half 2nd crop	Salmon, morrell and portion gimlet	May and July	Good	Mould-board	4	Springtype cultivated March. Planted with bar drill	Greasley	Mid April	60	80	Copper carbonate	Yes	Traces Takeall and Flying Smut.

## CULTURAL DETAILS.

*Light Land.*

Competitor.	No. years cropped.	Timber.	When ploughed.	Condition of land.	Implement.	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Glenvor Pastoral Co.	1	Scrubplain	July	Good	Disc	In. 4	Disc cultivated 2½ in. deep prior to seeding	Nabawa	End April ...	48	150	No	Yes	
Millstead, W. H.	2	Sandplain	Sept.	Good	Disc.	3	Disc cultivated 2 in. deep prior to seeding	Nabawa	End April ...	45	112	Copper carbonate	Yes	Trace Takeall.
Roberts, I. B.	1	Sandplain	Sept.	Wet	Mould-board	4½	Disc cultivated 2½ in. deep prior to seeding	Nabawa	Mid April ...	60	112	Copper carbonate	Re-cleaned	
Robinson, J. & Sons	2	Scrubplain	July	Good	Mould-board	4	Springtyne cultivated prior to seeding	Glueclub	2nd week April	60	140	Copper carbonate	Yes	
Millstead Bros.	1	Sandplain	Aug.	Good	Disc	4-5	Disc cultivated 2½ in. prior to seeding	Dollar	End April ...	45	112	Copper carbonate	Yes	Traces takeall, Ball Smut and Flying Smut.

## DOWERIN AGRICULTURAL SOCIETY.

Ten crops were submitted for inspection in this society's competition. Awards were made as follow:—

## DOWERIN AGRICULTURAL SOCIETY.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

Competitor.	District.	Variety.	Yield, 50 pts.	Free- dom from weeds, 10 pts.	Free- dom from Dis- ease, 10 pts.	Free- dom from admixture, 15 pts.	Even- ness of growth, 15 pts.	Total, 100 pts.
Williams, G. ...	Hindmarsh ...	Waratah ...	32	9	8	14	14	77
Bear, H. E. ...	Minnivale ...	Canberra ...	30	9	9	14	14	76
Cosh, E. C. ...	Minnivale ...	Waratah ...	32	9	8	13	13	75
Hughes, J. B. ...	Minnivale ...	Nabawa ...	28	8	9	14	13	72
Anderson, J. S. ...	Dowerin ...	Pusa ...	29	8	8	13	13	71
Kelly, W. ...	Dowerin ...	Nabawa ...	25	8	9	13	13	68
Jones, A. ...	Ejandling ...	Nabawa ...	23	9	8	14	13	67
Cook, E. ...	Dowerin ...	Gluyas Late ...	23	9	8	13	13	66
Kelly, W. ...	Dowerin ...	Nabawa ...	21	9	9	13	14	66
Thomas, T. ...	Dowerin ...	Nabawa ...	20	9	9	14	14	66

Mr. G. Williams was again successful in securing first place. His crop, of the variety Waratah, was calculated to yield 32 bushels per acre, and gained 77 points. This was a good, even, well-headed crop. The weeds were confined to a few wild oats, the disease to traces of Take-all and Flag Smut, and the admixture to odd plants of barley.

The land had been previously prepared by ploughing in the previous July to a depth of 4 inches. Subsequently it was springtyne cultivated in September, and again in early May. The crop was planted during the last week in May with a combined cultivator-drill, 50 lbs. of dry-pickled ungraded seed being applied per acre, together with 75 lbs. of superphosphate.

The rainfalls, as recorded at the various centres in the Dowerin district during the year, were as follow:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.		
Dowerin ...	...	...	71	117	57	393	328	264	76	40	1,158	3	1,489
Ejandling ...	...	...	26	135	53	301	237	150	46	18	805	5	1,064
Minnivale ...	...	25	163	102	47	401	264	186	77	29	1,004	...	1,395

The cultural details of the competitors are summarised below:—

## CULTURAL DETAILS

Competitor.	No. of years cropped.	Timber.	When ploughed.	Condition of land.	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Williams, G.	10	Salmon and gimlet	July	Good	Disc	in.	Springtype cultivated early Sept. and early May. Planted with combined cultivator drill with light harrows attached	Waratah	4th week May	50	75	Copper carbonate	No	Traces of Takeall and Flag Smut
Beaz, H. E. ...	Old land	Salmon, morrel and odd gimlet	July	Good	Disc	3	Rimtype cultivated Sept. Harrowed early Nov. Rimtype cultivated May. Planted with combined cultivator drill with light harrows attached	Cuthbert	Mid May	50	80	Copper carbonate	Recleaned	Trace of Flag Smut
Cosh, E. C. ...	3	Salmon, gimlet, and clay bush	July	Good	Disc	3	Springtype cultivated end Aug. and Sept. Planted with combined cultivator drill	Waratah	4th week April	45	100	Copper carbonate	Recleaned	Traces of Flag Smut and Ball Smut
Hughes, J. R.	Old land	Gimlet and salmon	July	Good	Mould-board	4	Disc cultivated 2in. deep Sept. Rimtype cultivated 1st week May. Planted with combined cultivator drill with light harrows attached	Nabawa	2nd week May	45	100	Copper carbonate	Yes	Trace of Takeall
Anderson, I. S.	Old land	Morrel and gimlet	Late July	Fair	Mould-board	3½	Harrowed twice Sept. Springtype cultivated prior to seeding. Planted with combined cultivator drill and harrowed immediately after	Pusa	2nd and 3rd weeks June	45	90	Copper carbonate	Yes	Traces of Flag Smut and Takeall
Kelly, W. ...	Old land	Salmon and gimlet	July	Good	Mould-board	4	Disc cultivated 2in. deep Sept. and before seeding	Nabawa	End March	70	120	Copper carbonate	Yes	Trace of Takeall
Jones, A. ...	4	Sandplain and scrub	June	Good	Disc	3½	Harrowed three times and cultivated just after ploughing	Nabawa	2nd and 3rd weeks April	45-50	120	Copper carbonate	Yes	Trace of Ball Smut

CULTURAL DETAILS.—continued.

Competitor.	No. years cropped.	Timber.	When ploughed.	Condition of land.	Implement.	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Cook, E. ...	Old land	Salmon and gimlet	July	Good	Mould-board.	in. 2½	Springtime cultivated Oct. Disc cultivated 2in. deep before seeding	Glucas Late	2nd week June	60	80	Fine stone	Yes	Traces of Takeall and Flag in admixture
Kelly, W. ...	1	Tussocky sandplain	July and Aug.	Good	Disc	3	Disc cultivated 2in. deep in March	Nabawa	1st. and 2nd weeks April	40	140	Copper carbonate	Yes	
Thomas, T. ...	4	Tussocky sandplain	Late July and early Aug.	Good	Disc	2½	Disc cultivated 1½in. deep before seeding	Nabawa	1st week May	37	90	Copper carbonate	Yes	

### WYALKATCHEM AGRICULTURAL SOCIETY.

All of the nine crops entered for the Wyalkatchem Agricultural Society's competition were inspected. The following awards were made:—

#### WYALKATCHEM AGRICULTURAL SOCIETY.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

Competitor.	District.	Variety.	Yield 50 pts.	Free- dom from weeds, 10 pts.	Free- dom from Dis- ease, 10 pts.	Free- dom from Admix- ture, 15 pts.	Even- ness of growth, 15 pts.	Total, 100 pts.
Jones, W. W. ...	Cowcowing ...	Nabawa ...	31	9	9	12	14	75
Lehman, C. E. ...	Cowcowing ...	Gluchub ...	31	9	8	12	14	74
Hodgson H. ...	North Korre- locking	Merredin ...	31	8	7	13	14	73
Vernon Estate ...	Nembudding ...	Ford ...	28	9	8	13	13	71
Lockyer, J. B. ...	Dukin ...	Gluyas Early	26	9	8	13	14	70
Chester & Sons ...	Wyalkatchem...	Nabawa ...	26	8	9	12	14	69
Robinson, S. W. ...	Cowcowing ...	Merredin ...	23	9	8	13	14	67
Tyler, J. E. ...	Korrelocking ...	Nabawa ...	23	9	9	13	13	67
Wilson, T. H. ...	Wyalkatchem...	Nabawa ...	25	7	9	14	12	67

Three competitors gained yields calculated at 31 bushels per acre. Of these Mr. W. W. Jones was placed first. The winning crop lost points through admixture, but the growth was even, it was comparatively free of weeds, and, except for Flag Smut in admixture, was free of disease.

The rainfalls, as recorded at the various centres in the district, are shown hereunder:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Cowcowing ...	...	...	151	160	47	395	196	136	44	36	854	7	80	1,252
Korrelocking ...	...	15	63	147	42	363	237	181	70	37	930	7	...	1,162
Wyalkatchem ...	...	56	53	135	63	335	247	161	68	27	901	7	100	1,252

The cultural details of the competitors are summarised hereunder:—

## CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed	Condition of land.	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Jones, W. W.	3	Salmon and gimlet	June and July	Good	Disc	4 in.	Disc cultivated 4 in. deep early Aug.; drilled with combined cultivator drill with light harrows attached	Nabawa	Mid-April ...	45	75	Copper carbonate	Yes	Trace of Flag Smut; trace in admixture
Lehman, C. E.	4	Morrel, Salmon and mallee	June	Excellent	Disc	4	Springtine cultivated Sept.; drilled with combined cultivator drill	Gluehub	Mid-May ...	37	90	Copper carbonate	Yes	Trace of Flag Smut; trace Bunt in admixture
Lodgson, H....	Old land	Salmon, gimlet and mallee	June & early July	Good	Mould-board	4	Disc cultivated 2 1/2 in. deep Aug.; springtine cultivated Oct.; drilled with combined cultivator drill with light harrows attached	Morredin	2nd week May...	45	90	Copper carbonate	Re-cleaned	Traces of Flag Smut, Ball Smut, Flying Smut and Takeall
Permon Estate	4	Gimlet running to tea-tree	March, 1929	Fair	Disc	3	Mouldboard ploughed June, 1929, 4 in. deep; disc cultivated 2 in. deep Sept.; springtine cultivated twice Mar.; harrowed April	Ford	End April ...	45	90	Copper carbonate	Yes	Traces of Flag Smut and Takeall
Rockyer, J. B.	3	Morrel, Salmon and some gimlet	June and July	Excellent	Disc	4	Springtine cultivated end Aug.; harrowed Sept. and Nov.; drilled with combined cultivator-drill followed by harrows	Gilvas Early	End April ...	45	100	Copper carbonate	Re-cleaned	Traces Ball Smut and Flag Smut
Shester, S. C., & Sons	Old land	Gimlet ...	Early June	Good	Mould-board	3 1/4 in.	Rigid tyme cultivated early Aug.; springtine cultivated late Aug.; harrowed Oct.; springtine cultivated Mar.; rigid-tyme cultivated April. Planted with combined cultivator drill with harrows attached	Nabawa	End April ...	45	100	Copper carbonate	Yes	Trace Flying Smut



CULTURAL DETAILS—continued.

Competitor.	No. years cropped.	Timber.	When ploughed.	Condition of land.	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Grated.	Disease.
Robinson, S. W.	6	Salmon and gimlet	Early July	Good	Disc	in 4	Disc cultivated 2 in. deep Aug.; springtime cultivated March. Planted with combined cultivator drill with light harrows attached	Merredin	End April ...	50	90	Copper carbonate	Yes	Trace Rail Smut and Flag Smut
Tyler, J. E. ...	10	Chiefly salmon with yorkgum, mallee and gimlet mixed	June	Excellent	Mould-board	4	Disc cultivated 2 in. deep Aug.; springtime cultivated early Sept.; harrowed and Sept. springtime cultivated and harrowed prior to seeding. Planted with combined cultivator drill with light harrows attached	Nabawa	2nd week May	45	120	Copper carbonate	Yes	
Wilson, T. H.	Old land	Portion gimlet and portion scrub	August	Wet	Mould-board	4	Disc cultivated late Sept.; harrowed Oct.; disc cultivated before seeding	Nabawa	3rd week April	50	100	Copper carbonate	Yes	

## ROYAL AGRICULTURAL SOCIETY---ZONE 3.

The competitors in this competition comprise the first and second prize winners in the Wongan Hills, Dowerin and Wyalkatchem Agricultural Societies' crop competitions, together with an entry received direct by the Royal Agricultural Society.

The awards made were as follow:—

## ROYAL AGRICULTURAL SOCIETY.

## ZONE 3.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

Competitor.	District.	Variety.	Yield 50 pts.	Free- dom from weeds, 10 pts.	Free- dom from Dis- ease, 10 pts.	Free- dom from Admix- ture, 15 pts.	Even- ness of growth, 15 pts.	Total, 100 pts.
Mt. Rupert Co. ...	Wongan Hills...	Merredin ...	35	9	8	13	14	79
Glenvor Pastoral Co. ...	Wongau Hills...	Nabawa ...	32	9	9	14	14	78
Williams, G. ...	Dowerin ...	Waratah ...	32	9	8	14	14	77
Bear, H. E. ...	Dowerin ...	Canberra ...	30	9	9	14	14	76
Jones, W. W. ...	Wyalkatchem...	Nabawa ...	31	9	9	12	14	75
Fordham, N. A. ...	Royal ...	Waratah ...	31	8	9	13	13	74
Lehman, C. E. ...	Wyalkatchem...	Gluehul ...	31	9	8	12	14	74

The competition was won by the Mt. Rupert Co., Wongan Hills, with a crop of Merredin, estimated to yield 35 bushels per acre.

The rainfall for the year was as hereunder:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Wongan Hills ...	...	...	95	117	92	477	275	192	66	57	1,759	...	153	1,524
Dowerin ...	...	...	71	117	57	393	328	264	76	40	1,158	3	140	1,489
Wyalkatchem ...	...	56	53	135	63	335	247	161	68	27	901	7	100	1,252
Calingiri ...	...	16	68	91	101	424	395	274	161	46	1,401	16	60	1,652

The cultural details are as follow:—

CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed.	Condition of land.	Implement.	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Mt. Rupert Co.	Old land	Salmon, morrel and gimlet	Early Sept.	Hard	Wool-board	4 in.	Harrowed and springtype cultivated Sept.; harrowed early Nov.; springtype cultivated early May. Planted with combined cultivator drill and harrowed after	Merredin	End May	80	80	Copper carbonate	Yes	Trace Smut
Glencor Pastoral Co.	1	Scrub-plain	July	Good	Disc	4	Disc cultivated 2 1/2 in. deep prior to seeding	Nabawa	End April	48	150	Untreated.	Yes	
Williams, G. ...	10	Salmon and gimlet	July	Good	Disc	4	Springtype cultivated early Sept. and May. Planted with combined cultivator drill with light harrow attached	Waratah	4th week May	50	75	Copper carbonate	No	Trace Smut
Bear, H. E. ...	Old land	Salmon, morrel and odd gimlet	July	Good	Disc	3	Rigid-type cultivated early Sept.; harrowed early Nov.; rigid-type cultivated May. Planted with combined cultivator drill with light harrows attached	Camberra	Mid-May	50	80	Copper carbonate	Re-cleaned	Trace Smut
Jones, W. W.	3	Salmon and gimlet	June-July	Good	Disc	4	Disc cultivated 4 in. deep early Aug. Planted with combined cultivator drill with light harrows attached	Nabawa	Mid-April	45	75	Copper carbonate	Yes	Trace Smut in admixture
Fordham, N. A.	Old land	Salmon, jam and lammas	Early Aug.	Fair	Wool-board	4	Springtype cultivated prior seed. Planted with hoe drill	Waratah	Mid-April	60	150	Copper carbonate	Yes	Trace of Take-all
Lehman, C. E.	4	Morrel, salmon and malice	June	Excellent	Disc	4	Springtype cultivated Sept.; drilled with combined cultivator drill	Glueclub	Mid-May	37	90	Copper carbonate	Yes	Traces Smut and Bunt in admixture

## ZONE 4.

Judge—G. L. THROSSELL, Dipl. Agric., Agricultural Adviser.

Royal Society—5 competitors.

Mt. Marshall Society—4 competitors.

Nungarin Society—12 competitors.

Total—21 competitors.

## MT. MARSHALL AGRICULTURAL SOCIETY.

Only four entries were received in this competition, and all were submitted for inspection. The points awarded were as follows:—

## MT. MARSHALL AGRICULTURAL SOCIETY.

Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.

Competitor.	District.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Total. 100 points
Thompson, M. A.	North Bencubbin	Nabawa ...	24	8	9	13	13	67
Collins, M. C. ...	Bencubbin ...	do. ...	24	8	8	13	13	66
Hopwood, B. W. G.	do. ...	do. ...	23	9	8	13	12	65
Wendt, E. ...	Weilbungin ...	Gluyas Early	21	8	8	12	14	63

A crop of Nabawa, calculated to yield 24 bushels per acre, submitted by Mr. M. A. Thompson, of North Bencubbin, won the competition with an award of 67 points. This crop was on land which had been ploughed 4 inches deep in July with a disc implement, and which had received two workings with a spring-tyne cultivator, viz., August, and prior to seeding. It was planted with a combined cultivator drill at the end of April, seed being applied at the rate of 38 lbs. and superphosphate 118 lbs. per acre.

Only one point separated the second prize winner, Mr. W. C. Collins, whose crop of Nabawa, although estimated would yield the same as the winning crop, lost a point for the presence of Septoria.

The rainfall during the year was as follows:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
North Bencubbin ...	...	6	173	241	47	480	169	164	64	15	939	...	62	1,421
Bencubbin ...	...	21	17	219	58	447	193	128	74	18	918	2	34	1,211

The cultural details are set out hereunder:—

CULTURAL DETAILS.

Competitor.	No. of years cropped.	Timber.	When ploughed	Implement	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed	Rate of super.	Seed treatment	Graded.	Disease.
Thompson. M. A.	...	Salmon and gimlet	July	Disc	in. 4	Good	Springtime cultivated Aug., Nov. and prior to seeding. Planted with combined cultivator drill	Nabawa	End April ...	lb. 38	lb. 118	Copper carbonate	Yes	Takeall
Collins. M. C.	...	Salmon and gimlet	June	Mould-board	4	Good	Disc harrowed Sept. and prior to seeding. Planted with combined cultivator drill	Nabawa	End April ...	47	60	Copper carbonate	Yes	Takeall toria
Hopwood. B. W. G.	Unknown. Cleared 1909	Gimlet, mal-lee and jam scrub	July-Aug.	Disc	4	Fairly good	Springtime cultivated in Sept. and Nov.; planted with combined cultivator drill	Nabawa	1st week May	45	120	...	Yes	Takeall toria
Wendt E. ...	Unknown. cleared 1912	Salmon, gimlet and morrie	July-Aug.	Disc	3	Dry	Cultivated with a combined cultivator drill in April. planted with same implement	Gluyas Early	Mid-May ...	39	70	Copper carbonate	Yes	Flag Smut

## NUNGARIN AGRICULTURAL SOCIETY.

Of the fifteen entries in this competition, twelve were submitted for judging, the awards being as follow:—

## NUNGARIN AGRICULTURAL SOCIETY.

Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.

Competitor.	District.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Total. 100 points
Manuel, C. J. ...	Mukinbudin	Gluyas Early	30	8	9	14	14	75
Watson Bros. ...	Nungarin	Carrabin	31	9	8	13	13	74
Johnson, J. H. ...	Mangowine	Gluyas Early	30	9	8	12	14	73
Williams, F. A. ...	do.	Nabawa	29	8	8	14	14	73
Clamp, A. ...	Mukinbudin	Gluyas Early	29	9	8	13	13	72
Creagh Bros. ...	Kwelkan	Carrabin	27	9	8	13	13	70
Jolly, H. P. ...	Mangowine	Nabawa	28	9	7	13	13	70
Waterhouse, H. H. ...	Nungarin	do.	27	8	8	13	13	69
Richardson, J. ...	Mukinbudin	do.	26	9	7	12	14	68
Pope Bros. ...	Kununoppin	Gluyas Early	24	8	8	14	14	68
Philbey, J. G. ...	Nungarin	Ford	24	9	7	12	14	66
Reynolds, A. G. ...	Mukinbudin	Gluyas Early	24	9	8	13	12	66

Mr. C. J. Manuel, of Mukinbudin, was the successful competitor, his entry being a very fine crop of Gluyas Early, which was estimated to yield 30 bushels per acre.

The land on which the crop was grown originally carried a forest of salmon gum and gimlet. It was ploughed during July with a mouldboard to a depth of 3½ inches, and was springtyne cultivated in August and prior to seeding, which took place during the first week in May, a disc drill being used. Seed and superphosphate were applied at the respective rates of 52 lbs. and 75 lbs. per acre.

The crop was a tall, dense and very even one, and, with the exception of a little barley grass, was free of weeds, while only a trace of Flag Smut was noticed.

It will be observed that 52 lbs. of graded seed were sown per acre. This is heavier than the usual rate recommended for this area, and while the object of sowing thickly was to overcome barley grass, the thick seeding had a detrimental effect towards the end of the growing season, when the spring rains were very light. Thus, while the crop was a very fine one, it did not yield as well as it looked. For the Mukinbudin district it is not considered advisable to exceed 40 lbs. per acre, and farmers should refer to the results of the experiments conducted at the Yilgarn Experiment Farm.

The rainfall, as recorded at the various centres in this competition, was as follows:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Mukinbudin ...	...	0	62	249	36	397	142	174	128	16	803	5	66	1,281
Nungarin ...	...	24	204	230	64	324	196	155	80	21	840	1	101	1,400
Kununoppin ...	...	13	175	191	47	306	192	172	123	25	865	2	43	1,289

The cultural details are as hereunder:—

CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed	Implement	Depth	Condition of land.	Subsequent cultivations	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Manuel, C. J.	...	Salmon and gimlet	July	Mould-board	in 3½	Good	Springtyne cultivated Aug. and prior seeding; Planted with disc drill	Guyas Early	1st week May ...	52	72	Copper carbonate	Yes	Trace Smut
Watson Bros.	Unknown; cleared 1912	Salmon and gimlet	July	Disc	4	Good	Reploughed Sept.; cultivated with combined cultivator drill Oct. and March, and planted with same implement	Carrabin	3rd week April...	48	90	Copper carbonate	Yes	Flag Smut and Takeall
Johnson, J. H.	4	Salmon and gimlet	June-July	Disc	4	Good	Springtyne cultivated July and Aug.; sown ploughed Sept.; harrowed Sept. and Nov.; springtyne cultivated Mch., and planted with combined cultivator drill	Guyas Early	Mid-May ...	60	80	Copper carbonate	Yes	Flag Smut
Williams, F. A.	6	Salmon and gimlet	June	Rigid-tyne scarifier	3½	Good	Rigid-tyne scarified and harrowed Sept. and Nov.; harrowed Mch. Planted with a combined cultivator drill	Nabawa	End April ...	45	75	Copper carbonate	Yes	Takeall trace Smut
Clamp, A. ...	4	Salmon and gimlet	June	Disc	4	Good	Cultivated with a combined cultivator drill July, Sept. and March; harrowed Sept. Planted with combined drill	Guyas Early	Mid-May ...	50	60	Copper carbonate	Yes	Flag Smut and Takeall
Creagh Bros....	Unknown; cleared 1920	Salmon and gimlet	June-July	Disc	4	Good	Springtyne cultivated Aug., Oct., Nov. and Mar. Planted with a combined cultivator drill	Carrabin	Mid-May ...	45	95	Copper carbonate	Yes	Takeall trace Smut
Jolly, H. P....	...	Salmon, gimlet, morrel and mallee	July	Mould-board	3-4	Good	Harrowed Sept. and March. Planted with combined cultivator drill	Nabawa	End April ...	45	65	Copper carbonate	Yes	Flag Smut and Takeall

CULTURAL DETAILS—continued.

Competitor.	No. years cropped.	Timber.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Waterhouse, H.	Unknown; cleared 1913	Salmon and gimlet	July	Mould-board	in. 4	Good	Reploughed with disc Aug.; springtine cultivated Nov. and March. Planted with a combined cultivator drill	Nabawa	2nd week April	45	85	...	Yes	Takeall
Richardson, J.	4	Salmon and gimlet	June-July	Mould-board	3-4	Good	Planted with a combined cultivator drill	Nabawa	1st week May ...	45	75	Copper carbamate	Yes	Ball Smut and Takeall
Pope Bros. ...	Unknown; cleared 1917	Salmon and gimlet and morrell	June	Mould board	4	Good	Disc cultivated Sept.; springtine cultivated and harrowed March. Planted with combined cultivator drill	Gluyas Early	End April ...	45	80	Copper carbamate	Yes	Trace Takeall and Flag Smut
Philbey, J. G.	Unknown; cleared 1913	Salmon and gimlet	July	Disc	3	Good	Reploughed end Sept.; springtine cultivated end Feb. Planted with combined cultivator drill	Ford	Mid-May ...	45	110	Copper carbamate	Yes	Flag Smut
Reynolds A. G.	1st	Mallee, jam scrub, tea-tree and white gum	June	Disc	4	Good	Cultivated with combined cultivator drill Aug. and Mar. Planted with same implement	Gluyas Early	Mid-May ...	45	90	Copper carbamate	Yes	Flag Smut



## ROYAL AGRICULTURAL SOCIETY—ZONE 4.

The competitors in this competition include the first and second prize winners in the Nungarin and Mt. Marshall District Agricultural Societies' crop competitions, together with the entries made direct with the Royal Agricultural Society. There were five of these individual entries, and they were located at such widely distributed localities as Corinthian, Southern Cross, Dulyalbin, Trayning, and Mukinbudin.

The awards were as follow:—

## ROYAL AGRICULTURAL SOCIETY—ZONE 4.

Judge: G. L. Throssell, Dipl., Agric., Agricultural Adviser.

Competitor.	District.	Society.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Total 100 points
Manuel, C. J.	Mukinbudin	Nungarin...	Gluyas Early	30	8	9	14	14	75
Watson Bros.	Nungarin...	do. ...	Carrabin	31	9	8	13	13	74
Davies, R. E. R.	Southern Cross	Royal ...	Nabawa...	29	9	9	13	13	73
Smeeton, F. ...	Trayning...	do. ...	Ford ...	27	9	8	13	13	70
White, E. T. ...	Mukinbudin	do. ...	Nabawa...	26	9	9	12	13	69
Davies, F. & J.	Corinthian	do. ...	do. ...	26	9	9	13	12	69
Thompson, M. A.	North Ren- cubbin	Mt. Marshall	do. ...	24	8	9	13	13	67
Collins, M. C.	Beneubbin	do. ...	do. ...	24	8	8	13	13	66
Sulter, R. J. ...	Dulyalbin	Royal ...	do. ...	20	9	9	14	12	64

Mr. C. J. Manuel, of Mukinbudin, was, therefore, successful in winning the Zone Championship prize, with Messrs. Watson Bros., of Nungarin, filling the second place.

The rainfall recorded at the various centres is shown in the accompanying table:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for year.	
					May.	June.	July.	Aug.	Sep.	Oct.				Total.
Mukinbudin ...	...	6	62	249	36	397	142	174	128	16	893	5	66	1 281
Nungarin ...	...	24	204	230	64	324	196	155	80	21	840	1	101	1,400
Corinthian ...	...	4	55	191	90	347	126	155	55	23	796	30	77	1 153
Turkey Hill ...	...	...	45	228	150	278	101	153	46	...	728	4	201	1,206
Trayning ...	...	17	191	162	60	343	216	136	58	21	834	...	90	1,294
Dulyalbin ...	...	...	...	...	34	348	204	174	89	19	868	15	34	917

The cultural details of the competitors are summarised in the following table:—

Competitor.	No. years cropped.	Timber.	When ploughed	Implement	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed Treatment.	Graded.	Disease.
Manuel, C. F.	...	Salmon and gimlet	July	Mould-board	in. 3½	Good	Springtine cultivated Aug. and prior to seeding. Planted with a disc drill	Gluyas Early	1st week May...	lb. 52	lb. 72	Copper carbonate	Yes	Trace Smut
Waton Bros.	Unknown cleared 1912	Salmon and gimlet	July	Disc	4	Good	Re-ploughed Sept. Cultivated with a combined cultivator drill Oct. and Mar., and planted with same implement	Carrabin	3rd week April	48	90	Copper carbonate	Yes	Trace Smut and Takeall
Davies, R. E. R.	1st	Salmon, gimlet and mallee	June-July	Disc	4	Good	Cultivated with combined cultivator drill Sept. and planted with same implement	Nabawa	1st week April	80	75	Copper carbonate	Yes	
Smeeton, F.	3	Salmon, gimlet and mallee	July	Disc	3½-4	Good	Cultivated with disc Oct. springtine cultivated with combined cultivator drill Oct. Planted with combined cultivator drill	Ford	3rd week April	45	75	Copper carbonate	Yes	Flag Smut, Takeall
White, E. T.	...	Salmon and gimlet	June	Disc	4	Good	Cultivated with disc Aug. springtine cultivated Sept. Oct. and April. Planted with a disc drill	Nabawa	Mid-April ...	45	95	Copper carbonate	Yes	
Davies F. & J.	1st	Salmon gimlet and mallee	July	Disc	4	Good	Cultivated with a combined cultivator drill Sept. and planted with same implement	Nabawa	Mid-April ...	34	80	Copper carbonate	Yes	
Thompson, M. A.	...	Salmon and gimlet	July	Disc	4	Good	Springtine cultivated Aug. Nov. and prior to seeding. Planted with a combined cultivator drill	Nabawa	End April ...	38	118	Copper carbonate	Yes	Takeall
Collins, M. C.	...	Salmon and gimlet	June	Mould-board	4	Good	Disc harrowed Sept. prior to seeding. Planted with combined cultivator drill	Nabawa	End April ...	47	60	Copper carbonate	Yes	Takeall
Suiter, R. J.	1st	Salmon, gimlet, and mallee	July	Disc	3	Good	Harrowed in April. Planted with combined cultivator drill	Nabawa	Mid-April ...	22	50	Copper carbonate	Yes	

## ZONE 5.

Judge—G. L. THROSSELL, Dipl. Agric., Agricultural Adviser.

Royal Society—1 competitor.

Merredin Society—13 competitors.

Bruce Rock Society—6 competitors.

Total—20 competitors.

## MERREDIN AGRICULTURAL SOCIETY.

Thirteen crops were submitted for judging in this competition, although originally there were twenty-one entries. The awards made were as follow:—

## MERREDIN AGRICULTURAL SOCIETY.

Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.

Competitor.	District.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Total. 100 points
Teasdale, H. W....	Totadgin ...	Nabawa ...	39	8	9	13	14	83
Cook, W. ...	S. Waigoolan ...	do. ...	38	9	8	13	14	82
Merredin Meat Co. ...	Merredin ...	Canberra ...	35	8	8	14	14	79
Maughan, J. D. ...	S. Waigoolan ...	Glyuas Late ...	35	8	8	12	14	77
Teasdale, Bros. ...	Belka ...	Nabawa ...	34	8	7	14	13	76
Thyne Bros. ...	Norpa ...	Merredin ...	31	8	8	14	13	74
Walder, L. S. ...	Merredin ...	Merredin ...	34	9	8	7	14	72
Rowan, C. H. ...	Totadgin ...	Nabawa ...	28	8	8	14	13	71
Maughan, T. G. & J. ...	Nukarni ...	do. ...	27	8	7	13	12	67
Smallacombe, T. H. ...	Nangeenan... ..	Canberra ...	24	8	8	14	13	67
Kay, J. ...	Buandee ...	Glyuas Early ...	26	7	7	13	13	66
Snell, C. ...	Nangeenan ...	Nabawa ...	27	8	6	12	12	65
Cockram, W. ...	Nukarni ...	Nabawa ...	21	8	8	13	13	63

The winner was Mr. H. W. Teasdale, of Totadgin, who entered a very fine crop of Nabawa, which was estimated to yield 39 bushels per acre, and which was awarded 83 points. The land, which originally carried gimlet, had been cleared since 1917, and was ploughed at the end of July with a mouldboard plough to a depth of 3½ inches, and cultivated with a rigid tyne scarifier in September, and after the heavy March rains. The crop was sown during the last week in April, 43 lbs. of graded seed and 120 lbs. of superphosphate per acre being applied. This crop was very tall and dense, and excepting for a few wild oats, was very free of weeds.

By winning this competition Mr. Teasdale wins outright the coveted "Teasdale Cup," which was presented by the Teasdale Bros. in 1922. The conditions attached to this cup were that it had to be won twice in succession or three times in all. Since 1922 no less than seven farmers have earned the honour of having

their names engraved on this cup, but Mr. H. W. Teasdale is the only winner who has held the cup on more than one occasion. The list of successful competitors is as follows:—

*Teasdale Cup*.—1922, R. Pollock; 1923, H. W. Teasdale; 1924, the late W. G. Woolgar; 1925, Teasdale Bros.; 1926, H. W. Teasdale; 1927, C. H. Rowan; 1928, T. H. Smallacombe; 1929, W. Cook; 1930, H. W. Teasdale.

The rainfall recorded at the various centres throughout the district is as hereunder:—

					Growing Period.								Total for year.		
					May.	June.	July.	Aug.	Sep.	Oct.	Total.	Nov.		Dec.	
Merredin ... ..	...	...	1	213	272	51	375	223	181	91	38	959	...	31	1,476
Nangeenan ... ..	...	...	1	315	218	38	325	177	229	81	44	894	4	85	1,517
Koonadgin ... ..	...	...	...	206	379	43	401	203	180	84	20	931	4	89	1,609
Belka ... ..	...	...	36	323	187	78	376	246	196	50	31	977	4	31	1,558
Nukarni ... ..	...	...	...	266	159	39	314	182	178	43	12	768	...	125	1,318
Baandee ... ..	...	...	...	165	220	58	295	155	197	54	12	771	...	22	1,178

A very noticeable feature of some of the competing crops was the prevalence to a very marked degree of the disease Take-all. This disease was responsible for a reduction in yield in the badly infected crops. As it was, however, the average yield of the thirteen competitors was 31 bushels per acre. This average could have been higher if the Take-all had been controlled by better farming methods in the past. As this disease is the consequence of indifferent methods, competitors should refer to page 85, where the question is discussed.

The cultural details are summarised below:—

## CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Treasdale, H. W.	Unknown, cleared 1917	Gimlet	July-Aug.	Mould-board	In. 3½	Good	Rigid tyre scarified Sept. and Mar. Planted with a combined cultivator drill	Nabawa	End April ...	lb. 43	lb. 120	Copper carbonate	Yes	Trace Takeall and Septoria
Cook, W. ...	5	Salmon, gimlet and mallee	June-July	Disc	3-4	Good	Rigid tyre scarified Aug. and Sept. Skin ploughed Mar. Planted with a combined cultivator drill	Nabawa	End April ...	43	100	Copper carbonate	Yes	Takeall
Merredin Meat Co.	...	Gimlet, salmon and mallee	May	Mould-board	4	Good	Rigid tyre scarified Aug., Sept., Nov., and April. Planted with combined cultivator drill	Canberra	1st week May...	54	180	Copper carbonate	Yes	Flag Smut, Takeall and Bunt
Maughan, J. D.	4	Gimlet	April	Combined cultivator drill	3	Good	Cross ploughed Aug.; springtyne cultivated Sept., Nov., and prior to seeding. Planted with combined cultivator drill	Gilgus Late	1st week May ...	45	100	Copper carbonate	Yes	Takeall and Flag Smut
Treasdale Bros.	Unknown, cleared 1914	Salmon and gimlet	June	Mould-board	3	Good	Springtyne cultivated Sept., Nov., and Mar. Disc ploughed prior to seeding. Planted with combined cultivator drill	Nabawa	1st week May ...	45	94	...	Yes	Takeall
Thyne Bros.	...	Salmon and gimlet	June	Disc	4	Good	Reploughed with Disc Aug. Springtyne cultivated Sept., Oct., Mar. and Apl. Planted with combined cultivator drill	Merredin	Mid-May ...	45	75	Copper carbonate	Yes	Flag Smut
Walden, L. S.	...	Salmon, gimlet and morrel	July-Aug.	Disc	3	Good	Springtyne cultivated Oct.; rigid-tyne scarified prior to seeding. Planted with combined cultivator drill	Merredin	Last week April; first week May	35	90	Copper carbonate	Yes	Flag Smut

CULTURAL DETAILS—*continued*.

Competitor.	No. years cropped.	Timber.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed Treatment.	Graded.	Disease.
Rowan, C. H.	...	Salmon and gimlet	Feb.	Rigid-tine scarifier	in. 24	Dry	Ploughed with mould-board June; harrowed July; rigid-tine scarified end July; harrowed Nov.; spring-tine cultivated in May. Planted with combined cultivator drill	Nabawa	Mid-May	lb. 40	lb. 112	Copper carbonate	Yes	Takeall, Trace Bunt
Maughan, T. J. & G.	6-7	Salmon and gimlet	July	Disc	4	Good	Cross ploughed early Aug.; spring-tine cultivated Aug.-Sept. Planted with combined cultivator drill	Nabawa	1st week May	45	75	Copper carbonate	Yes	Takeall and Bunt
Smallacombe, T. H.	...	Mallee and jam scrub	July	Disc	4	Good	Spring-tine cultivated in March. Planted with combined cultivator drill	Comet	1st week May	53	87	Copper carbonate	Yes	Flag Smut
Kay, J.	...	Salmon, gimlet, morrell and tea-tree	July	Mould-board	3½	Good	Spring-tine cultivated Sept., Nov., followed by harrowing; disc cultivated and rigid-tine scarified prior seeding. Planted with combined cultivator drill	Gluyas Early	End May	45	90	Copper carbonate	Yes	Traces Takeall, Flag Smut
Snell, C.	Unknown: cleared 1906	Salmon and gimlet	July	Disc	3-4	Good	Cultivated with combined cultivator drill Sept.; rolled in Feb. Planted with combined cultivator drill	Nabawa	1st week May	45	110	Copper carbonate	Yes	Takeall
Cockram, W.	Unknown: cleared 1918	Salmon and gimlet	July	Disc	4-5	Good	Disc cultivated Aug.; spring-tine cultivated Sept.; disc cultivated April. Planted with disc drill	Nabawa	2nd week May	45	80	Copper carbonate	Yes	Takeall

## BRUCE ROCK AGRICULTURAL SOCIETY.

There were six competitors in the crop competition conducted by the Bruce Rock Agricultural Society, the awards being as follow:—

## BRUCE ROCK AGRICULTURAL SOCIETY.

Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.

Competitor.	District.	Var.ety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Total. 100 points
Smith, C. & Sons	Yarding ...	Glueclub ...	43	9	9	13	14	88
Ellis, E. G. ...	Central Kuminin	do. ...	39	9	8	12	14	82
Strange, P. A. ...	Yarding ...	do. ...	38	9	8	13	13	81
Smith, C. & A. H.	Yalbarin ...	do. ...	38	9	7	13	14	81
Farrall, F. C. & Sons	Yarding ...	do. ...	35	9	8	12	13	77
Strachan, W. ...	Yarding ...	do. ...	36	8	7	12	13	76

Messrs. C. Smith & Sons, of Yarding, won the competition with an entry of the variety Glueclub, which was awarded 83 points, and which was estimated to yield 43 bushels per acre. This entry was portion of a paddock of 580 acres of the same variety. The land on which the crop was sown originally carried a forest of salmon gum and gimlet, which was cleared in 1910. It was ploughed with a disc implement in June and July to a depth of three inches, and was disc cultivated in August and September, cultivated with a combined cultivator-drill in April, and planted with the same implement. Seeding took place during the second week in May, the rates of seed and superphosphate being 46 lbs. and 93 lbs. per acre respectively. This crop was well grown, very free of weeds and disease, but lost points for admixture. In addition to gaining the Zone Championship, this crop was awarded the special prize for the highest bushel yield in the State.

The average yield of all competitors in this competition was 38 bushels per acre.

The rainfall recorded at the various centres in the district is shown in the table hereunder:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May	June	July	Aug.	Sep.	Oct.	Total.			
Bruce Rock ...	...	...	216	192	64	342	254	194	107	26	987	...	49	1,444
Yarding ...	...	...	209	134	72	340	252	194	124	31	1,053	...	15	1,420
Central Kuminin	...	9	137	162	79	367	303	436	133	29	1,047	9	35	1,399

The cultural details of competitors have been summarised in the following table:—

CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed.	Implement	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Grated.	Disease.
Smith, C., & Sons	Unknown, cleared 1910	Salmon and gimlet	June-July	Disc	in. 3	Fair	Cultivated with disc Aug. and Sept., and combined cultivator drill in April, planted with same implement	Glueclub	2nd week May	lb. 46	lb. 93	Copper carbamate	Yes	Trace Flag Smut
Ellis, E. G. ...	Gimlet	Gimlet and jam	June	Disc	3-4	Good	Cultivated with disc in July; cultivated with a combined cultivator drill in Nov., and planted with same implement	Glueclub	Mid-May	50	90	Copper carbamate	Yes	Takeall and Flag Smut
Strange, P. A.	6	Salmon, gimlet, and morrel	June	Disc	3-4	Good	Cultivated with disc Sept.; Springtype cultivated Oct., March and May. Planted with combined cultivator drill	Glueclub	Mid-May	50	93	Copper carbamate	Yes	Takeall, Septoria and Flag Smut
Smith, C. & A. H.	...	Salmon and gimlet	June	Mould-board	3	Good	Cultivated with disc Sept.; Springtype cultivated Oct. and Apr. Planted with combined cultivator drill	Glueclub	1st week May...	45	90	Copper carbamate	Re-cleaned	Ball Smut and Takeall
Farrell, F. C. & Sons	9	Salmon, gimlet, and morrel	June	Mould-board	4	Good	Portion Springtype cultivated June, balance cultivated with disc end Aug. Rigid type scarified Sept., springtype cultivated Sept., Nov., March. Planted with combined cultivator drill	Glueclub	Last week April	48	108	Copper carbamate	Yes	Takeall
Strachan, W.	2	Salmon and gimlet	July-Aug.	Disc	3½	Fairly good	Cultivated with disc end Sept., cultivated with springtype cultivator Sept. and end Nov. Planted with combined cultivator drill	Glueclub	Mid-April	60	90	Copper carbamate	...	Takeall, Septoria and Flag Smut



## ROYAL AGRICULTURAL SOCIETY—ZONE 5.

The competitors in this competition include the first and second prize winners in the Merredin and Bruce Rock District Agricultural Societies' Crop Competitions, together with an entry received direct by the Royal Agricultural Society.

The awards were as follow:—

## ROYAL AGRICULTURAL SOCIETY—ZONE 5.

Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.

Competitor.	District.	Society.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Total. 100 points
Smith, C. & Sons	Yarding ...	Bruce Rock	Glucub ...	43	9	9	13	14	88
Teasdale, H. W.	Totadgin ...	Merredin ...	Nabawa...	39	8	9	13	14	83
Ellis, E. G. ...	Central ...	Bruce Rock	Glucub ...	39	9	8	12	14	82
Cook, W. ...	Kumminin ...								
	South Wal- goolan	Merredin ...	Nabawa...	38	9	8	13	14	82
Hammond, J. D.	Kellerberrin	Royal ...	Nabawa	25	8	7	13	12	65

The crop of Messrs C. Smith & Sons, of Yarding, in addition to winning the Zone Championship, won the special prize of £5 5s. awarded annually by the Royal Agricultural Society for the highest bushel yield in the State. A yield of 43 bushels per acre is certainly a fine achievement, and is only three bushels less than the official State record of Mr. C. E. Cockram, of Pallinup, whose crop of Yandilla King in 1929 yielded 46 bushels per acre.

The rainfall for the districts where the competitors are located was as follows:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Yarding ...	...	9	209	134	72	380	252	194	124	31	1,053	...	15	1,420
Ulva ...	...	13	526	291	68	383	247	256	91	36	1,081	...	81	1,992
Koonadin ...	...	...	206	379	43	401	203	180	84	20	931	4	89	1,609
Central Kumminin...	...	9	137	162	79	367	303	136	133	29	1,047	9	35	1,399
Kellerberrin ...	...	5	164	227	52	376	239	222	109	26	1,024	5	...	1,425

The cultural details are as follow:—

CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber	When ploughed	Implement	Depth	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed Treatment.	Graded.	Disease.
Smith, C. & Sons	Unknown: Cleared 1910	Salmon and gimlet	June-July	Disc	in. 3	Fair	Disc cultivated Aug. and Sept.; cultivated with combined drill cultivator April and planted with same implement	Glueclub	2nd week May...	46	93	Copper carbonate	Yes	Trace Smut
Treadale, H. W.	Unknown: cleared 1917	Gimlet ...	July-Aug.	Mould-board	3½	Good	Rigid tyre scarified Sept. and March; ploughed with combined cultivator drill	Nabawa	End April ...	43	120	Copper carbonate	Yes	Trace Takeall and Septoria
Ellis, E. G. ...	...	Gimlet and jam	June	Disc	3-4	Good	Disc cultivated July; cultivated with combined cultivator drill Nov. and planted with same implement	Glueclub	Mid-May ...	50	90	Copper carbonate	Yes	Takeall Flag Smut
Cook, W. ...	5	Salmon, gimlet, morrel and mallee	June-July	Disc	3-4	Good	Rigid tyre scarified Aug. and Sept. sown ploughed March; ploughed with combined cultivator drill	Nabawa	End April ...	43	100	Copper carbonate	Yes	Takeall
Hammond, J. D.	2	Gimlet ...	July-Aug.	Mould-board	4	...	Discd once, springtime cultivated several times	Nabawa	Mid-May ...	60	112	Copper carbonate	Yes	Takeall

## ZONE 7.

Judge—J. H. LANGFIELD, Manager, Merredin Experiment Farm.

Royal Society—no competitors.

Karlgarin Society—5 competitors.

Lake Grace Society—10 competitors.

Kulin Society—15 competitors.

Total—30 competitors.

## KARLGARIN AGRICULTURAL SOCIETY.

In the Karlgarin Agricultural Society's competition there were twelve entries, but seven withdrew before inspection. The awards were as follow:—

## KARLGARIN AGRICULTURAL SOCIETY.

Judge: J. H. Langfield, Manager, Experimental Farm, Merredin.

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total. 100 points
			50 points	10 points	10 points	15 points	15 points	
Biglin, E. J. ...	Karlgarin ...	Gluyas Early ...	32	8	8	12	13	73
Treasure, C. ...	do. ...	Turvey ...	28	8	9	11	13	69
Metcalf, G. ...	do. ...	Gluyas Early ...	25	9	9	12	13	68
Howlett, A. ...	do. ...	Nabawa ...	26	9	7	13	13	68
Shawyer, C. ...	do. ...	Nabawa ...	24	9	8	13	13	67

Mr. E. J. Biglin was placed first with a crop of Gluyas Early, which was estimated to yield 32 bushels per acre. Mr. C. Treasure was placed second with a crop of Turvey, with an estimated yield of 28 bushels per acre.

A fair amount of admixture was present in most of the crops in this competition, but as the district has been 25 to 30 miles from a railway, the difficulty in getting pedigree seed is quite apparent. Now that a railway is being constructed through the district, farmers should secure a few bags of pedigree seed.

The rainfall for East Karlgarin during the year is shown in the following table:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
East Karlgarin ...	...	3	342	172	112	302	334	206	87	29	1,070	30	64	1,681

The cultural details are as follow:—

CULTURAL DETAILS.

Competitor.	Timber.	When ploughed.	Implement.	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed Treat-ment	Graded.
Biglin, E. J.	Salmon and gimlet	July	Rigid-tyne scarifier	Ins. 2½-3	Spring-tyne cultivated and harrowed Sept., Nov., and Mar. Sown with combined cultivator drill	Gilyas Early	Early May ...	lbs. 45	lbs. 60	Copper carbonate	Yes
Treasure, C.	Morrel, mallee and gimlet	End June	Disc. cultivator	3	Worked back with same implement Sept. Harrowed Nov. and sown with combined cultivator drill	Turvey ...	Late April ...	45	98	Copper carbonate	Yes
Metcalf, G. ...	Salmon, mallee and morrel	August	Disc.	3½-4	Spring-tyne cultivated Sept., and harrowed. Harrowed again before seeding. Sown with disc drill	Gilyas Early	Mid May ...	58	70	Copper carbonate	Yes
Howlett, A.	Gimlet, salmon and morrel	July and August	Disc. cultivator	3	Spring-tyne cultivated Sept. and twice harrowed. Disc cultivated last week May. Sown with disc drill	Nabawa ...	Early June ...	40	45	Copper carbonate	No
Shawyer, C.	Salmon, gimlet and morrel	October	Disc cultivator	4	Spring-tyne cultivated Nov. Sown with disc drill and spring-tyne cultivated after drilling	Nabawa ...	Early May ...	45	60	Copper carbonate	Yes

## LAKE GRACE AGRICULTURAL SOCIETY.

In this competition there were originally twelve entries, but two competitors withdrew before inspection.

The awards were as follow:—

## LAKE GRACE AGRICULTURAL SOCIETY.

Judge: J. H. Langfield, Manager, Experimental Farm, Merredin.

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admix- ture.	Even- ness of Growth.	Total.
			50 points	10 points	10 points	15 points	15 points	100 points
Coad, H. J. ...	Lake Grace	Nabawa ...	35	9	9	14	14	81
Collinson & Fleay ...	do. ...	Gluyas Late ...	33	9	9	14	13	78
Bishop, H. F. ...	do. ...	Nabawa ...	31	9	9	14	14	77
Woodburn, J. ...	do. ...	Yandilla King ...	31	9	9	14	14	77
Fry, E. H. ...	do. ...	Gluyas Early ...	31	9	9	13	14	76
Burns, E. B. ...	do. ...	Yandilla King ...	29	8	8	14	13	72
Griffiths & Green ...	do. ...	Caliph ...	27	9	9	13	13	71
Griffin, C. ...	Neendalling ...	Bena ...	24	8	8	14	12	67
Hadden, C. F. ...	Burngup ...	Nabawa ...	25	8	8	14	12	67
Witham & Sons ...	Lake Biddy	Gluyas Early ...	20	7	8	14	12	61

The winning entry was shown by H. J. Coad, the variety being Nabawa, and the estimated yield 35 bushels per acre. It was thick, even, free from weeds, disease, or admixture, and would be a creditable exhibit in any competition.

Messrs. Collinson and Fleay were placed second with a very fine crop of Gluyas Late, estimated at 33 bushels per acre and, like the winning crop, had very few faults.

Messrs. H. F. Bishop, J. Woodburn, and E. H. Fry all exhibited splendid crops, and although only 50 acres were inspected, they all had a much larger area that would yield equally as well.

The average yield over the ten crops inspected in this competition was 28.6 bushels per acre.

Below is given the rainfall for 1930:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Lake Grace ...	...	17	70	180	133	382	504	102	95	44	1,260	3	54	1,584
Lake Biddy ...	...	25	317	227	124	305	291	155	86	43	1,004	...	...	1,573

The cultural details are as follow:—

## CULTURAL DETAILS.

Competitor.	Timber.	When ploughed.	Implement.	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seeds.	Rate of super.	Seed Treatment.	Graded.
Ad, H. J.	Gimlet, blackbutt and yorrel	July	Disc cultivator	ins. 3½	Springtine cultivated three times in Spring and once before seeding. Sown with combined cultivator drill	Nabawa	End April	lb. 45	lb. 130	Copper carbonate	Yes
Alinson & Play	Salmon and gimlet	August	Disc cultivator	3½	Springtine cultivated before seeding. Sown with disc drill and harrowed	Glycas Late	Early May	45	80	Copper carbonate	No
Shop, H. F.	Gimlet	Late June	Disc cultivator	3	Springtine cultivated Sept. Planted with combined cultivator drill	Nabawa	End April	45	120	Copper carbonate	Yes
Goodburn, J.	Morrel and blackbutt	Late July	Disc cultivator	3½	Springtine cultivated Aug. and Nov., and before seeding. Sown with disc drill	Yandilla King	Mid April	50	120	Copper carbonate	No
Fy, E. H.	Salmon and morrel	End June	Disc cultivator	3½	Disc cultivated Aug. Harrowed three times before end Dec. Sown with combined cultivator drill	Glycas Early	Mid May	60	135	Copper carbonate	Yes
Jurbs, E. E.	Morrel and salmon	Early July	Disc cultivator	3-4	Springtine cultivated Sept. and Nov. Sown with combined cultivator drill	Yandilla King	Mid April	50	125	Copper carbonate	Yes
Griffiths & Green	Gimlet, morrel and yorrel	August	Disc cultivator	3	Springtine cultivated Sept. Disc cultivated before seeding. Sown with disc drill	Caliph	Early June	50	80	Formalin	With- nosed
Griffin, C.	Salmon and madua gum	June and July	Disc cultivator	3-4	Springtine cultivated Sept. Disc cultivated before seeding. Sown with combined plough-drill	Bona	End April	50	120	Formalin	No
Madden, C. F.	Salmon and morrel	August	Disc	3	Ploughed back in Spring. Harrowed before seeding. Sown with disc drill	Nabawa	End April	45	100	Copper carbonate	Yes
Witham & Sons	Salmon and morrel	End July	Disc cultivator	3	Ploughed back in Oct. Some sown with drill and some with combined plough drill	Glycas Early	June	50	60	Copper carbonate	No

## KULIN AGRICULTURAL SOCIETY.

The competition conducted by this Society was well contested, the winning entry being calculated to yield 37 bushels, while the lowest yield was better than eight bags. The awards were as follow:—

## KULIN AGRICULTURAL SOCIETY.

Judge: J. H. Langfield, Manager, Experiment Farm, Merredin.

Competitor.	District.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Total. 100 points
Henderson, J. H....	Gnarning ...	Queen Fan ...	37	9	9	14	14	83
Bowey & Baldock	Kulin ...	Ford ...	33	9	9	13	14	78
Bowey, P. J. ...	do. ...	do. ...	32	9	9	13	14	77
Lewis, R. H. ...	do. ...	do. ...	31	9	9	13	14	76
Nichols, R. ...	do. ...	Gluyas Early ...	30	9	8	14	13	74
Parker, C. W. ...	do. ...	Merredin ...	30	9	8	14	12	73
Trotter, A. W. ...	Kulin Rock ...	Bena ...	30	7	9	13	13	72
Bailey & Russell ...	Kulin ...	Merredin ...	29	8	9	13	13	72
Freebairn, F. S. ...	do. ...	Queen Fan... ..	28	9	9	13	13	72
Biggin, H. ...	Kondinin ...	Nabawa ...	26	8	8	14	14	70
Bowey, Mrs. ...	Kulin ...	Queen Fan ...	25	9	9	13	13	69
Clarke, A. H. & J. H.	do. ...	do. ...	27	8	8	13	13	69
Hodgson, J. H. ...	do. ...	Gluyas Late ...	28	8	7	13	12	68
Scadding, M. ...	do. ...	Queen Fan... ..	25	8	9	13	13	68
Melkle, P. ...	do. ...	Gluyas Late ...	27	8	8	13	12	68

Mr. H. J. Henderson was awarded first place in the Kulin competition with a crop of Queen Fan. This also secured first place in Zone 7. It was calculated to yield 37 bushels per acre. It was a well stooled, even crop, very free from disease and admixture. Mr. Henderson had similar success with the same variety last year, when the yield was calculated at 28 bushels compared with 37 bushels this year.

Second place went to Messrs. Bowey and Baldock with a crop of Ford. This was also a very fine crop and gave a calculated yield of 33 bushels per acre. Third and fourth places were secured by Mr. P. J. Bowey and R. H. Lewis respectively, both with Ford, the yields of which were estimated at 32 and 31 bushels per acre.

For the fifteen crops entered in this Society's competition the average calculated yield was 29.2 bushels per acre.

Flag Smut and Take-all was noticed in many crops, Gluyas Early being the most affected with Flag Smut, whilst to a lesser degree it was found in Merredin, Queen Fan and Gluyas Late. Take-all was showing in many crops, but in most cases would not greatly reduce the yield.

Mr. Parker's crop at Merredin was down very badly. This could be attributed mainly to planting too early; it had been sown the latter end of April and had made a wonderful growth of foliage. Had it been sown a fortnight to three weeks later the yield of grain would have been equally as good, whilst the growth of straw would have been restricted and the liability to lodge greatly reduced.

The rainfall during the year was as follows:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total. for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Kulin ... ..	...	6	212	210	89	400	455	174	71	36	1,225	8	73	1,734
Kondinin ... ..	...	...	126	181	68	312	364	155	144	32	1,075	7	50	1,439

The cultural details are summarised in the table below --

## CULTURAL DETAILS

Competitor	Timber	When ploughed	Implement	Depth	Subsequent cultivations	Variety	Planted	Rate of seed	Rate of super	Seed treatment	Graded
Henderson, J H	Yorkgum morrel and salmon	Early July	Rigid tyne scarifier	ins	Harrowed Aug Springtine cultivated Sept and Mar Sown with combined cultivator drill and harrowed after	Queen Fern	Mid May	lb 45	lb 112	Copper carbonate	Yes
Bowey & Baldock	Salmon	Mid July	do	3	Springtine cultivated Oct and Mar Sown with combined cultivator drill	Ford	End of April	50	100	Copper carbonate	Yes
Bowey, P I	Salmon and morrel	August	do	2-3	Springtine cultivated Oct Rigid tyne scarifier Mar Sown with combined cultivator drill	Ford	End of April	50	100	Copper carbonate	Yes
Lewis R H	Jam salmon and mallee	June	do	2	Crossed with rigid tyne scarifier Aug Springtine cultivated March Harrowed Sown with combined cultivator drill and again harrowed	Ford	End of April	60	112	Copper carbonate	Yes
Nichols, R	Salmon Yorkgum and jam	July	Disc	3	Turned back Aug Springtine cultivated Sept Sown with combined cultivator drill	Glueas Early	End week May	60	80	Copper carbonate	Yes
Parker C W	Salmon morrel and blackbutt	August	Disc	3	Disc cultivated Nov Sown with combined cultivator drill	Merri lin	End of April	40	90	Copper carbonate	Yes
Trotter A W	Jam and forest	July	Disc		Turned back Oct Sown with combined cultivator drill	Bell	Mid April	40	128	Copper carbonate	Yes
Bailey & Russell	Salmon gimlet and morrel	July	Disc cultivated	3 1/4	Ploughed back Sept Harrowed Nov Sown with combined cultivator drill	Merri lin	Mid May	40	95	Copper carbonate	Yes
Freebairn F S	Salmon Yorkgum jam	August	Disc	4	Harrowed Sept Springtine cultivated Oct Harrowed Oct Springtine cultivated Mar Sown with combined cultivator drill	Queen Fern	Mid April	60	90	Copper carbonate	Yes
Biggin H	Salmon and gimlet	July	Disc cultivated	3 1/4	Disc cultivated Aug Springtine cultivated Mar Sown with combined cultivator drill	Neluma	Early May	48	100	Copper carbonate	Renewed
Bowey Mrs	Salmongum	August	Rigid tyne scarifier	2 1/2	Harrowed Oct Springtine cultivated Mar Sown with combined cultivator drill	Queen Fern	Mid April	50	90	Copper carbonate	Yes



CULTURAL DETAILS—continued.

Cooperator.	Timber.	When ploughed.	Implement.	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.
Hodgson, J. R. ...	Gimlet, salmon, and morrel	Summer fallow Mar., 1929	Disc cultivator	Ins. 3	Disc cultivated July. Rigid-type scarified Sept. Springtype cultivated Nov. and April. Sown combined cultivator drill	Late Gluyas	Mid May	lb. 55	lb. 90	Copper carbonate	Yes
Scadding, M. ...	Gimlet, morrel, Tea-tree	July	Disc cultivator	3	Springtype cultivated Mar. Sown combined cultivator drill	Queen Pan	Mid April	60	70	Copper carbonate	Yes
Clarke, A. H. & J. H.	Morrel, merritt, malice	August	Disc	3	Rigid-type scarified Sept. Springtype cultivated Mar. Sown with combined cultivator drill	Queen Pan	End of April	56	100	Copper carbonate	Yes
Melkie, P. ...	Salmon, gimlet	July	Mouldboard	4	Cross ploughed with disc cultivator plough Sept. Springtype cultivated and harrowed Oct. Sown with combined cultivator drill	Late Gluyas	Early May	38	90	Copper carbonate	Yes

## ROYAL AGRICULTURAL SOCIETY--ZONE 7.

There were no individual competitors in this zone who entered direct with the Royal Agricultural Society, so that the competition was confined to the first and second prize winners of the Kulin, Karlgarin and Lake Grace Societies, the awards being as shown in the accompanying table:—

## ROYAL AGRICULTURAL SOCIETY--ZONE 7.

Judge: J. H. Langfield, Manager, Experiment Farm, Merredin.

Competitor.	District.	Agricultural Society.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Total. 100 points
Henderson, J. H.	Gnarining	Kulin ...	Queen Fan	37	9	9	14	14	83
Coad, H. J. ...	Lake Grace	Lake Grace	Nabawa ...	35	9	9	14	14	81
Bowey & Bald- dock	Kulin ...	Kulin ...	Ford ...	33	9	9	13	14	78
Collinson & Fleay	Lake Grace	Lake Grace	Gluyas Late	33	9	9	14	13	78
Biglin, E. J. ...	Karlgarin	Karlgarin...	Gluyas Early	32	8	8	12	13	73
Treasure, C. ...	Karlgarin	Karlgarin...	Turvey ...	28	8	9	11	13	69

The honour of winning the Zone Championship was won by Mr. J. H. Henderson of Gnarining, who gained the highest number of points with his entry of Queen Fan.

The cultural details of these prize winners have been grouped in the following table for comparison:—

CULTURAL DETAILS.

Competitor.	Timber.	When ploughed.	Implement.	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed Treatment.	Graded.
Henderson, J. H. ...	Yorkgum, morrel and salmon	Early July	Rigid-tyne scarifier	ins. 3	Harrowed August. Spring-tyne cultivated Sept. and Mar. Sown with combined cultivator drill and harrowed	Queen Fan ...	Mid May ...	lb. 45	'b 112	Copper carbonate	Yes
Dodd, H. J. ...	Gimlet, blackbutt and morrel	July	Disc. culti-vator	3½	Spring-tyne cultivated three times in spring and once before seeding. Sown with combined cultivator drill	Nabawa ...	End April ...	45	150	Copper carbonate	Yes
Bowey & Baldoock ...	Salmon	Mid July	Rigid-tyne scarifier	3	Spring-tyne cultivated Oct. and Mar. Planted with combined drill cultivator	Ford ...	End April ...	50	100	Copper carbonate	Yes
Dollinson & Fleay ...	Salmon and gimlet	August	Disc. culti-vator	3½	Spring-tyne cultivated before seeding. Planted with disc drill and harrowed	Gluyas Late ...	Early May ...	45	80	Copper carbonate	No
Biglin, E. J. ...	Gimlet and salmon	July	Rigid-tyne scarifier	2½-3	Spring-tyne cultivated and harrowed Sept., Nov., and Mar. Sown with combined culti-vator drill	Gluyas Early ...	Early May ...	45	60	Copper carbonate	Yes
Treasure, C. ...	Morrel, mallee and gimlet	End June	Disc. culti-vator	3	Worked back with same implement Sept. Harrowed Nov. Sown with combined culti-vator drill	Turvey ...	Late April ...	58	70	Copper carbonate	Yes

## ZONE 8.

Judge: A. S. WILD, B.Sc. (Agric.), Agricultural Adviser.

Royal Society—2 competitors.

Gnowangerup Society—14 competitors.

Nyabing Society—5 competitors.

Total—21 competitors.

## GNOWANGERUP AGRICULTURAL SOCIETY.

Of the twenty-nine entries received for the competition conducted by this Society, fourteen crops were submitted for inspection.

The awards were made as follow:—

## GNOWANGERUP AGRICULTURAL SOCIETY.

Judge: A. S. WILD, B.Sc. (Agric.), Agricultural Adviser.

Competitor.	District.	Variety.	Yield, 50 pts.	Free- dom from weeds, 10 pts.	Free- dom from disease, 10 pts.	Free- dom from admix- ture, 15 pts.	Even- ness of growth, 15 pts.	Total, 100 pts.
White, R. H.	Pallinup ...	Yandilla King	38	9	9	14	13	83
Barnard, C. E.	Pallinup ...	Yandilla King	37	8	9	14	12	80
McDonald, J.	Gnowangerup...	Nabawa ...	35	9	9	14	12	79
Stewart, W. B.	Gnowangerup...	Yandilla King	34	9	9	13	13	78
Formby, R. & Co., Ltd.	Gnowangerup...	Yandilla King	32	9	9	13	13	76
Whyatt, C. A.	Pallinup ...	Yandilla King	30	9	9	14	13	75
Johnston, A.	Gnowangerup...	Nabawa ...	30	9	9	14	12	74
Taylor, C. ...	Pallinup ...	Yandilla King	31	8	9	14	12	74
Cockram, C. E.	Pallinup ...	Yandilla King	29	9	9	13	13	73
Murray, W. G.	Borden ...	Yandilla King	30	9	8	13	13	73
Lahoar, W. ...	Gnowangerup...	Bena ...	25	9	9	13	13	69
Moir, J. A. ...	Borden ...	Yandilla King	25	9	8	13	13	68
Pozzi, R. ...	Gnowangerup...	Drot ...	28	7	8	13	12	68
Wellard & Wellard	Gnowangerup...	Nabawa ...	26	8	9	13	12	68

Mr. R. H. White's crop of Yandilla King, calculated to yield 38 bushels per acre, was awarded first place in both the district and the No. 8 Zone Competitions.

This was a dense, well-headed crop, comparatively free of weeds, disease or admixture. The seed had been planted at the rate of 45 lbs. per acre and the superphosphate applied at the rate of 90 lbs. per acre during the third week in May. The land had been prepared by ploughing to a depth of 4 inches during July of the previous year. This was followed by a springtyne cultivation in October and another early in May. The seed was planted by means of a combined cultivator drill to which light drag harrows were attached.

The performance of the Gnowangerup district over the five years in which the Society has conducted crop competitions is undoubtedly meritorious. The average calculated yield (over 50-acre plots) of the 51 competitors since 1926 is 32.8 bushels. The lowest average of 30.7 bushels per acre was obtained by the fourteen competitors in 1930, and the highest of 35.4 bushels by the sixteen competitors in 1929.

Possibly these high figures are partially indicative of a cycle of good years, but they indeed show that good farming, fertile land, and favourable climatic conditions are not to be dissociated from the district.

The keen spirit of the competitors in the Gnowangerup district, and the competitions themselves, have played no small part in the advancement of yields. The attainment of good yields has become, not the aim of the few, but the realisation of the majority.

Skilful handling of fallow, so necessary in a district liable to the climatic conditions of 1930, is made easier by the comparatively small areas under wheat culture on each farm.

The time of seeding in this district is a matter of increasing importance. The tendency for late seeding is one which may over-step the limits of prudence, particularly when the tractive power of the farm is limited to one team of horses. Although we must admit the lateness of the district, it is perhaps sound advice that farmers should endeavour to complete their seeding operations by the middle of June.

The high yields obtained in the 1930 competition are not so indicative of the general high averages throughout the district as were those of the previous year. In several instances it was noted that the 50-acre areas, although not planted specifically as competition plots, were seeded at opportune times in a season which was decidedly erratic.

The rainfalls as recorded at Borden and Gnowangerup are given below:—

	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Borden ... ..	...	3	266	109	290	240	291	35	103	25	984	15	133	1,510
Gnowangerup ...	...	15	148	86	359	363	298	50	137	18	1,225	6	67	1,547

The cultural details of the competing crops are tabulated hereunder:—

## CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed.	Condition of land.	Implement.	Depth.	Subsequent cultivation.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
White, R. H.	Old land	Yorkgum...	July	Good	Mould-board	in. 4	Springtyne cultivated. Oct. and early May. Planted with combined cultivator drill, followed by light harrows	Vanilla King	Mid-May	lb. 45	lb. 90	Copper Carbonate	Yes	
Barnard, C. E.	7	Yorkgum, whitegum and morrel	Aug.	Hard	Mould-board	3½	Springtyne cultivated Sept. or early Oct. Planted with combined cultivator drill	Vanilla King	3rd week May	45	85	No	Yes	
McDonald, J.	Old land	Salmon, morrel and yorkgum	July and Aug.	Good	Mould-board	4	Harrowed end Aug. springtyne cultivated Oct. and Nov. Harrowed Feb., springtyne cultivated March and portion at end of May. Mould-board ploughed 2in. deep July. Planted with combined cultivator drill	Nubawa	1st week Aug.	55	140	Copper Carbonate	Yes	Trace of Rust
Stewart, W. B.	3	Morrel and yorkgum	Early July	Good	Mould-board	3	Springtyne cultivated Sept., Nov., and early April. Planted with combined cultivator-drill	Vanilla King	3rd week June	50	175	Copper Carbonate	Yes	Trace of Rust
Formby, R. & Co., Ltd.	1	Salmon and morrel	Late July	Good	Mould-board	3½	Springtyne cultivated Sept. Disc cultivated 2½in. deep Nov. Rigid tyne cultivated early April. Planted with combined cultivator-drill	Vanilla King	3rd week May	53	130	Copper Carbonate	Yes	Trace of Flying Smut
Whyatt, C. A.	5	Yorkgum and yate	Aug.	Fair	Mould-board	4	Harrowed Sept. Springtyne cultivated Sept., Oct., and May	Vanilla King	3rd week May	45	80	Copper Carbonate	Yes	

CULTURAL DETAILS—continued.

Competitor.	No. years cropped.	Timber.	when ploughed	Condition of land.	Implement.	Depth.	Subsequent cultivation.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Johnston, A.	3	Sheoak, manna gum and yorgum.	Aug.	Good	Mould-board	in 3	Rigid type cultivated twice before harvesting and once before seeding	Nahava	Mid-time	60	90	Copper Carbonate	Yes	
Taylor, C. ...	Old land	Yorgum and jam	June	Good	Mould-board	3½	Springtype cultivated Sept. and Oct. Planted with combined cultivator-drill	Yandilla King	3rd week May	62	93	Copper Carbonate	Yes	
Cockram, C. E.	Old land	Yorgum chiefly	Nov.	Patchy	Mould-board	4	Springtype cultivated Nov. Jan., April and May, planted with combined cultivator-drill	Yandilla King	Mid-time	55	150	Copper Carbonate	Yes	Trace of Rust
Murray, W. G.	1	Yorgum and jam	July	Hard	Disc	2 to 3	Springtype cultivated Sept. Nov. and Mar. Planted with combined cultivator-drill	Yandilla King	Mid-May	52	100	Copper Carbonate	Yes	Trace of Rust and Flying Smut.
Lahoor, W. ...	Old land	Salmon and yorgum	Aug.	Dry	Mould-board	4	Springtype cultivated twice Spring, 3 times Autumn and again before seeding. Planted with combined cultivator-drill	Bena	3rd week May	60	150	Copper Carbonate	Yes	Trace of Rust.
Moir, J. A. ...	1	Jam and sheoak	July and Aug.	Good	Disc.	4 to 5	Disc. cultivated 4in. deep Sept. Springtype cultivated April. Planted with combined cultivator-drill	Yandilla King	2nd and 3rd week May	60	125	Copper Carbonate	Yes	Rust.
Pozzi, R. ...	Old land	Chiefly salmon and jam	Nov.	Fairly Hard	Mould-board	3	Springtype cultivated wire before seeding. Planted with combined cultivator-drill	Drof	End May	58	90	Copper Carbonate	Yes	Traces of Rust and Ball Smut.
Wellard & Wellard	1	Salmon and jam	Nov.	Patchy	Mould-board	3½	Disc. cultivated 2½in. deep. end Nov. Springtype cultivated Mar. Planted with combined cultivator-drill	Nahava	End May	60	90	Copper Carbonate	Yes	Trace of Flying Smut.

## NYABING AGRICULTURAL SOCIETY.

Five crops were inspected in the competition organised by the Nyabing Agricultural Society, the awards being as follow:—

## NYABING AGRICULTURAL SOCIETY.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

Competitor.	District.	Variety.	Yield, 50 pts.	Free- dom from weeds, 10 pts.	Free- dom from disease, 10 pts.	Free- dom from admix- ture, 15 pts.	Even- ness of growth, 15 pts.	Total, 100 pts.
Slee, E. J. W.	Boongadoo ...	Major ... ..	36	7	8	12	13	76
Sargent, A. Med.	Boongadoo ...	Major ... ..	32	8	7	12	13	72
Tranter, C. O.	Pingrup ...	Nabawa ...	28	8	8	13	13	70
Stockden, P. ...	Pingrup ...	Yandilla King	26	9	8	12	12	67
Altham, G. ...	Pingrup ...	Gluyas Early ...	19	9	8	14	13	63

Both Messrs. Slee and Sargent had high yielding crops both of the variety Major. The winning crop had been planted early in May at the rate of 45 lbs. of graded seed per acre and 120 lbs. of superphosphate per acre. The land had been well prepared by ploughing 3½ inches deep with a mouldboard plough during July and August. It was springtine cultivated in September and again in October, disc-cultivated 2 inches deep in March and planted with a combined cultivator-drill.

The rainfall recorded at Pingrup during the year is shown hereunder:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Pingrup ... ..	...	13	207	103	186	367	308	81	128	36	1,106	6	53	1,578



The cultural details of the competitors are summarised below:—

CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed	Condition of land.	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Sles, E. J. W.	Old land	Morrel and yorgium	July and Aug.	Good	Mould-board	in. 3½	Springtyne cultivated Sept. and Oct. Disc. cultivated 2in. deep March. Planted with combined cultivator-drill	Major	Early May ...	lb. 45	lb. 120	Formalin	Yes	Trace ing Smut and Flag Smut.
Sargent, A. McD.	7	Morrel, salmon, mallee, white-gum, and jam	July and Aug.	Good	Mould-board	3½	Disc. cultivated 2in. deep Sept. Planted with combined plough drill	Major	1st and 2nd week May	45	100	Copper Carbonate	Yes	Trace Smut, Flag, and Smut.
Tranter, C. O.	3	Blackbutt and boree	July	Good	Disc.	3½	Springtyne cultivated Sept. Harrowed Nov. Planted with combined cultivator drill	Nabawa	End April ...	35	75	Copper Carbonate	Yes	Trace Ball and Flying Smut
Stockden, P.	4	Blackbutt, boree and salmon gum	June	Dry	Disc.	4	Springtyne cultivated Aug., Sept., Jan. and April	Yandilla King	2nd week April	45	45	Copper Carbonate and Formalin	Yes	Trace Smut and Rust.
Altham, G. ...	3	Morrel, gimlet and salmon	Aug.	Good	Disc.	4	Disc. cultivated 2in. deep Oct., and before seeding	Ghuyas Early	1st week June	60	90	Copper Carbonate	Yes	Trace all.

## ROYAL AGRICULTURAL SOCIETY—ZONE 8.

For the Royal Agricultural Society's competition in this zone two entries were received direct by the Royal Agricultural Society, and the other competitors were the first and second prize winners of the Nyabing and Gnowangerup crop competitions.

The awards were as follow:—

## ROYAL AGRICULTURAL SOCIETY—ZONE 8.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

Competitor.	Society.	Variety.	Yield. 50 pts.	Free- dom from weeds, 10 pts.	Free- dom from disease, 10 pts.	Free- dom from admixture, 15 pts.	Even- ness of growth, 15 pts.	Total, 100 pts.
White, R. H.	Gnowangerup...	Yandilla King	38	9	9	14	13	83
Barnard, C. E.	Gnowangerup...	Yandilla King	37	8	9	14	12	80
Richards, T.	Royal ...	Nabawa ...	33	8	9	14	13	77
Slee, E. J. W.	Nyabing ...	Major ...	36	7	8	12	13	76
Bryant, R. J.	Royal ...	Gluyas Early	27	9	8	14	14	72
Sargent, A. McD.	Nyabing ...	Major ...	32	8	7	12	13	72

The winner was Mr. R. H. White, of Palinup, whose crop of Yandilla King was awarded 83 points. It will be seen that the high standard was maintained this year, the lowest yield being 27 bushels per acre.

The monthly rainfall for the year was as hereunder:—

		Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for year.	
						May.	June.	July.	Aug.	Sep.	Oct.				Total.
Gnowangerup	...	...	15	148	86	359	363	298	50	137	18	1,225	6	67	1,547
Nyabing	...	...	33	69	129	315	443	423	107	127	52	1,467	10	22	1,730
Quairading	...	...	21	86	131	43	413	430	181	87	38	1,201	9	18	1,466

The cultural details are summarised in the accompanying table:—

CULTURAL DETAILS.

Competitor.	No. Years cropped.	Timber.	When ploughed	Condition of land.	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed Treatment.	Graded.	Disease.
White, R. H.	Old land	Yorkgum	July	Good	Mould-board	4 in.	Springtyne cultivated Oct. and early May. Planted with combined cultivator-drill followed by light harrows	Yandilla King	Mid-May ...	45 lb	90 b	Copper Carbonate	Yes	
Harward, C. E.	7	Yorkgum, whitegum, and morrel	Aug.	Hard	Mould-board	3½	Springtyne cultivated Sept. or early Oct. Planted with combined cultivator-drill	Yandilla King	3rd week May	45	85	No	Yes	
Richards, T.	Old land	Salmon, gimlet and morrel	July	Good	Mould-board	4	Springtyne cultivated Sept., Oct., and prior seeding. Planted with combined cultivator-drill	Nabawa	End May ...	48	168	Copper Carbonate	Yes	
Lee, E. J. W.	Old land	Morrel and Yorkgum	July-Aug.	Good	Mould-board	3½	Springtyne cultivated Sept. and Oct. Disc. cultivated 2in. deep March. Planted with combined cultivator-drill	Major	Early May ...	45	120	Formalin	Yes	Traces of Flying and Flag Smut
Bryant, R. J.	Old land	Salmon and gimlet	July	Good	Disc.	4	Springtyne cultivated and harrowed Sept. Planted with combined cultivator-drill	Gluyas Early	2nd and 3rd week May	75	95	Copper Carbonate	Yes	Traces Flag Smut.
Argent, McD	7	Morrel, salmon, mallee, whitegum, and jam	July-Aug.	Good	Mould-board	3½	Disc. cultivated 2in. deep Sept. Planted with combined plough-drill	Major	1st and 2nd week May	45	100	Copper Carbonate	Yes	Traces of Ball, and Flying Smut

## ZONE 9.

Judge: L. G. SEINOR, Manager, Experiment Farm, Salmon Gums.

Southern Mallee Society—23 competitors.

## SOUTHERN MALLEE AGRICULTURAL SOCIETY.

There were twenty-three entries in this competition, an increase of twelve upon the previous year. This is an indication that the farmers in the Esperance wheat area are alive to the value of competitions of this nature. The awards made were as follow:—

## SOUTHERN MALLEE AGRICULTURAL SOCIETY.

Judge: L. G. Seinor, Manager, Experiment Farm, Salmon Gums.

Competitor.	District.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Total 100 points
Waters, T. ...	Dowak ...	Ghuys Early ...	26	9	9	10	14	68
O'Kieffe, M. ...	Dowak ...	Ghuys Early ...	23	9	9	12	14	67
Sharpe, H. S. ...	Treslove ...	Nabawa ...	22	9	9	13	13	66
Snade Bros. ...	Kumari ...	Ghuys Early ...	20	9	9	14	13	65
Susella, J. ...	Circle Valley ...	Ghuys Early ...	22	9	9	14	11	65
Shaw, J. ...	Salmon Gums ...	Nabawa ...	22	8	9	14	12	65
Steele, S. C. ...	Treslove ...	Ghuys Early ...	22	9	7	14	13	65
Haywood, T. ...	East Salmon Gums ...	Nabawa ...	22	8	9	12	13	64
McCorkill, E. ...	Salmon Gums ...	Nabawa ...	22	8	9	12	12	63
Morton, N. ...	East Salmon Gums ...	Nabawa ...	19	9	9	12	13	62
McMahon, D. ...	Kumari ...	Nabawa ...	18	9	9	13	13	62
Potter, F. O. ...	Dowak ...	Nabawa ...	19	8	9	13	13	62
Thomas Bros. ...	Salmon Gums ...	Nabawa ...	18	9	9	12	13	61
Mosta, P. ...	Red Lake ...	Ghuys Early ...	19	9	9	12	12	61
Prince, E. ...	Kumari ...	Nabawa ...	20	7	8	11	12	58
Ritchie, D. ...	Grass Patch ...	Ghuys Early ...	20	8	6	11	12	57
Watson, A. ...	Circle Valley ...	Ghuys Early ...	18	8	7	12	11	56
Quick & Sons ...	Red Lake ...	Nabawa ...	19	8	7	12	10	56
McGrea, N. ...	East Salmon Gums ...	Nabawa ...	17	7	8	12	11	55
Grigg, Bros. ...	Scaddan ...	Nabawa ...	17	8	5	12	11	53
Flintham, H. ...	Scaddan ...	Nabawa ...	16	7	7	12	10	52
Storey, F. E. ...	Treslove ...	Baroota ...	19	6	6	10	11	52
Bradshaw, J. ...	Kumari ...	Wonder Nabawa ...	15	8	7	7	10	47

The winning crop of Mr. T. Waters, of West Dowak, of the variety Ghuys Early, was awarded 68 points, the calculated yield being 26 bushels per acre. This crop stood about 4ft. 6in. in height and was very well headed, but it lost heavily for admixture, though scoring well in other respects. The land originally carried silver bark and salmon gum and was ploughed 4in. deep in June with a disc implement. It was springtyne cultivated in November and harrowed prior to seeding. Graded and dry pickled seed was sown during the third week in May at the rate of 45 lbs., and superphosphate at 90 lbs. per acre.

Mr. M. O'Kieffe's crop of the same variety gained second place, while Mr. H. S. Sharpe, of East Treslove, who came third, gained the highest number of points for those competitors located in the southern portion of the area.

The rainfall for the various centres is shown in the table hereunder:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Dowak ...	2	...	229	145	209	156	67	221	74	19	746	13	288	1,423
Salmon Gums ...	...	...	300	187	281	143	98	246	65	17	850	8	...	1,345
Sunrise Hill ...	2	2	185	149	182	98	66	192	74	21	633	3	...	1,225
Circle Valley East ...	3	...	155	205	308	113	98	214	69	29	831	19	197	1,410
Red Lake ...	...	...	243	226	215	124	110	251	59	24	783	4	266	1,522
Grass Patch ...	3	2	295	271	251	129	112	278	108	35	913	6	237	1,727
Scaddan ...	2	...	325	333	289	150	80	251	73	30	873	20	221	1,774

A big improvement was noticed this year in the standard of the crops throughout the district. This also applies to the fallow prepared for the coming season's planting, and the good condition of most of the fallow seen during judging is an indication that the advice of the Department of Agriculture is having a beneficial influence. The average yield of the twenty-three competitors was 20 bushels per acre, an improvement of five bushels per acre over the previous year, when there were eleven competitors.

While in the course of judging, several other features in regard to the cropping methods were observed, namely—

1. *Admixture.*—This was due to two causes: (a) self-sown wheat, and (b) poor quality seed. In the early stages of farming without sheep, this is somewhat difficult to overcome, but the difficulty can be greatly lessened by more thorough cultivation. In this direction a heavier implement than the springtyne cultivator could be used to advantage during spring.

2. *Varieties.*—The standard and recommended varieties, Nabawa and Gluyas Early, were outstanding. Departure from these wheats, in most cases, led to various troubles, and in this respect the only other wheat grown in the competition, namely, Baroota Wonder Early, was very seriously affected by Rust.

3. *Diseases.*—Rust, Ball, and Loose Smut and Takeall were all too evident, and their control is more fully dealt with on pages 84 and 85 of this issue. These diseases were more common in the southern and older settled portions of this area than in the north. With such an efficient method as dry pickling with copper carbonate for the control of Ball Smut at the disposal of farmers, it really is surprising to find this disease prevalent in crops. An analysis of the cultural details shows that although copper carbonate was used by every competitor, infection was found in nine crops. This indicates that the operation of dry pickling was not done thoroughly.

In conclusion, the Society should be commended for fostering the crop competitions in this locality, for there is no doubt that much good will result therefrom.

The cultural details are summarised in the following table:—

CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed.	Condition of land.	Implement	Depth.	Subse plant cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Waters, T. ...	1st	Silver bark and salmon gum	June	Good	Disc	4 in.	Springtine cultivated Nov. Harrowed before seedling	Glucas Early	4th week May	45	90	Copper carbonate	Yes	
O'Kieffe, M. ...	1st	Silver bark, tea-tree and gimlet	June	Good	Disc	4	Harrowed and April before seedling	Glucas Early	3rd week May	40	80	Copper carbonate	Yes	Flag Smut
Sharpe, H. ...	1st	Light mal-lee and scrub	June	Good	Disc	3	Cross ploughed Oct. Springtine cultivated prior to seedling	Nabawa	4th week April	50	90	Copper carbonate	No	Flying Smut
Smale Bros.	1st	Salmon gum and gimlet	July-Aug.	Fair	Disc	4	Ridgely cultivated Nov. and harrowed prior to seedling	Glucas Early	3rd week May	40	85	Copper carbonate	Yes	
Sassella, J. ...	1st	Mallee gum 1st, glaucous broom bush	July	Good	Disc	3-4	Springtine cultivated Sept., prior to seedling	Glucas Early	2nd week May	30	80	Copper carbonate	Yes	
Shaw, J. P. ...	2nd	Black mal-lee and broombush	June-July	Good	Disc	4	Cross ploughed in Feb. and springtine cultivated prior to seedling	Nabawa	3rd week April	30	90	Copper carbonate	Yes	
Steele, S. C. ...	1st	Mallee and tea-tree scrub	June	Good	Disc	4	Harrowed in Sept., prior to seedling	Glucas Early	1st week May	45	90	Copper carbonate	No	Ball Smut
Haywood T.	1st	Gimlet silver bark, tea-tree scrub	May-June	Good	Twin Disc	4	Springtine cultivated Nov. Skim ploughed April. Springtine cultivated ahead of drill	Nabawa	4th week April	39	83	Copper carbonate	Yes	
McCorkill, E.	1st	Black mal-lee and scrub	June	Good	Disc	4	Springtine cultivated Oct. and Mar., and again prior to seedling	Nabawa	1st week May	40	90	Copper carbonate	Yes	
Morton, N. ...	1st	Broom-bush and light silver bark	July	Fair	Disc	4	Springtine cultivated Oct. and Nov., and prior to seedling	Nabawa	3rd week May	45	95	Copper carbonate	...	Flying Smut

CULTURAL DETAILS—continued.

Competitor.	No. years cropped.	Timber.	When ploughed.	Condition of land.	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
McMahon, D.	1st	Silverbark, gimlet and mallee	June	Good	Disc	in. 3	N7 ... ..	Nabawa	4th week April	40	90	Copper carbonate	Yes	Flying Smut
Potter, F. C.	1st	Silverbark and tea-tree	July	Good	Disc	4	Springtyne cultivated in Nov., and prior to seeding	Nabawa	Last week April and 1st week May	30	85	Copper carbonate	Yes	Trace of Rust
Thomas Bros.	1st	Silverbark, gimlet mallee and tea-tree	June	Good	Disc	4	Cross ploughed Feb., springtyne cultivated March	Nabawa	2nd week May	36	103	Copper carbonate	Yes	
Mosta, P. ...	1st	Scrub, light mallee	July	Good	Disc	4	Righttyne cultivated prior to seeding	Gluyas Early	2nd week May	42	75	Copper	No	Ball Smut
Prince, E. ...	1st	Black mallee, silverbark, gimlet and mallee	July	Fair	Mould-board	3-4	Springtyne cultivated Oct., Mar., and again prior to seeding	Nabawa	2nd week May	40	85	Copper carbonate	Yes	Trace Smut
Ritchie, D. ...	1st	Silverbark	June-July	Good	Disc	4	Harrowed Oct. and Mar. Cross ploughed Mar. Springtyne cultivated in April	Gluyas Early	2nd week May	45	80	Copper carbonate	No	Rust and Ball Smut
Watson, A. ...	3rd	Silverbark and tea-tree	July	Good	Disc	3-4	Springtyne cultivated Sept., Oct., and Nov., and again prior to seeding	Gluyas Early	3rd week May	45	90	Copper carbonate	Yes	Takeall and Ball Smut
Quick & Sons	1st	Light mallee	July-Aug.	Good	Disc	3-4	Cross ploughed in Mar. springtyne cultivated April, prior to seeding	Nabawa	Last week April, 1st week May	47	90	Copper carbonate	No	Ball Smut and Rust
McCrean, N. ...	2nd	Silverbark, gimlet and tea-tree	June	Good	Disc	4	Springtyne cultivated Nov., and again prior to seeding	Nabawa	1st week May	45	75	Copper carbonate	Yes	Ball Smut
Grigg Bros. ...	1st	Light mallee	June-July	Good	Disc	4	Cross ploughed and cultivated prior to drilling	Nabawa	Last week April	45	90	Copper carbonate	Yes	Rust and Ball Smut

CULTURAL DETAILS—continued.

Competitor.	No. years cropped.	Timber.	When ploughed.	Condition of land.	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of seed.	Seed treatment.	Graded.	Disease.
Flintham, C.	1st	Tanna thicker mallee and black mallee	May	Good	Twin Disc	in 4	Cross ploughed in Mar., and harrowed prior to seeding	Nabawa	3rd week May	51	103	Copper carbonate	Yes	Rust and Ball Smut
Storey, F. E.	1st	Light mallee scrub	July	Good	Disc	4	Cross ploughed Sept., Jan. and April	Barooda Wonder Early	3rd week April	70	110	Copper carbonate	No	Badly infected with Rust
Bradshaw, J.	2nd	Salmongum	June-July	Good	Disc	3-4	Springtyne cultivated Oct. and Feb.	Nabawa	3rd and 4th week April	39	80	Copper carbonate	No	Takall and Rust

\* All the crops were planted with disc drills.



## ROYAL AGRICULTURAL SOCIETY ZONE CHAMPIONSHIP AWARDS.

*Representatives from District Agricultural Societies' Competitions and entries received direct by Royal Agricultural Society.*

Competitor.	District.	Society.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Total. 100 points
ZONE 1.—Judge: I. Thomas, Superintendent of Wheat Farms.									
Bothe, B. D....	Coorow ...	Royal ...	Nabawa ...	35	8	8	14	13	78
Morcombe, P. T.	do. ...	do. ...	Felix ...	32	9	8	12	13	74
Hebiton, J. K.	Three Springs	Three Springs	Nabawa ...	31	8	8	12	13	72
Roberts, J. A.	Moora ...	Royal ...	Nizam ...	32	7	8	13	13	71
McKenzie, N.	Three Springs	Three Springs	Merredin ...	27	9	8	13	15	70
Forrester, J. K.	Carnamah	Royal ...	do. ...	29	7	8	13	12	69
Cumling, A. S.	do. ...	do. ...	Nabawa ...	25	7	8	11	11	62
Hopkinson, H. J.	Milling ...	do. ...	do. ...	16	9	9	13	10	57
ZONE 2.—Judge: F. L. Shier, B.Sc. (Agric.), Agricultural Adviser.									
Sutcliffe, J. G.	Damboring	Dalwallinu	Glucub ...	33	8	9	12	14	76
utcher, A. P.	Pithara ...	do. ...	do. ...	32	9	9	12	13	75
Porter, F. A.	Ajana ...	Royal ...	Nabawa ...	18	9	9	13	14	63
ZONE 3.—Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.									
Mt. Rupert Co.	Wongan Hills	Wongan Hills	Merredin ...	35	9	8	13	14	79
Glenvor Pastoral Co.	do. ...	do. ...	Nabawa ...	32	9	9	14	14	78
Williams, G. ...	Hindmarsh	Dowerin ...	Waratah ...	32	9	8	14	14	77
Bear, H. E....	Minnivale	do. ...	Canberra ...	30	9	9	14	14	76
Jones, W. W.	Cowcowing	Wyal-katchem	Nabawa ...	31	9	9	12	14	75
Fordham, N.	Calcarra...	Royal ...	Waratah ...	31	8	9	13	13	74
Lehman, C. E.	Cowcowing	Wyal-katchem	Glucub ...	31	9	8	12	14	74
ZONE 4.—Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.									
Manuel, C. J....	Mukinbudin	Nungarin...	Gluyas Early	30	8	9	14	14	75
Watson Bros.	Nungarin	do. ...	Carrabin	31	9	8	13	13	74
Davies, H. E.	Southern Cross	Royal ...	Nabawa ...	29	9	9	13	13	73
Smeeton, F. ...	Trayning	do. ...	Ford ...	27	9	8	13	13	70
White, E. T....	Mukinbudin	do. ...	Nabawa ...	26	9	9	12	13	69
Davies, F. & J.	Corinthian	do. ...	do. ...	26	9	9	13	12	69
Thompson, M. A.	North Bencubbin	Mt. Marshall	do. ...	24	8	9	13	13	67
Collins, M. C....	Bencubbin	do. ...	do. ...	24	8	8	13	13	66
Suiter, R. J....	Dulyalbin	Royal ...	do. ...	20	9	9	14	12	64
ZONE 5.—Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.									
Smith, C., & Sons	Yarding...	Bruce Rock	Glucub ...	43	9	9	13	14	88
Teasdale, H. W.	Totadgin	Merredin	Nabawa ...	39	8	9	13	14	83
Ellis, E. G. ...	Cent. Kumbinn	Bruce Rock	Glucub ...	39	9	8	12	14	82
Cook, W. ...	South Walgoolan	Merredin	Nabawa ...	38	9	8	13	14	82
Hammond, J. D.	Kellerberrin	Royal ...	Nabawa ...	25	8	7	13	12	65
ZONE 7.—Judge: J. H. Langfield, Manager, Experiment Farm, Merredin.									
Henderson, J. H.	Gnarmling	Kulin ...	Queen Fan	37	9	9	14	14	83
Coad, H. J. ...	Lake Grace	Lake Grace	Nabawa ...	35	9	9	14	14	81
Bowey, & Baldock	Kulin ...	do. ...	Ford ...	33	9	9	13	14	78
Collinson & Fleay	Lake Grace	Lake Grace	Gluyas Late	33	9	9	14	13	78
Bighin, E. J. ...	Karlgarin	Karlgarin...	Gluyas Early	32	8	8	12	13	73
Treasure, C. ...	do. ...	do. ...	Turvey ...	28	8	9	11	13	69

ROYAL AGRICULTURAL SOCIETY ZONE CHAMPIONSHIP AWARDS.—*continued.*

*Representatives from District Agricultural Societies' Competitions and entries received direct by Royal Agricultural Society—continued.*

Competitor.	District.	Society.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of growth. 15 points	Total. 100 points
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## ZONE 8.—Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

White, R. H.	Gnowan-gerup	Gnowan-gerup	Yandilla King	38	9	9	14	13	83
Barnard, C. E.	do.	do.	do.	37	8	9	14	12	80
Richards, T. ...	S. Caroling	Royal ...	Nabawa ...	33	8	9	14	13	77
Slee, E. J. W.	Nyabing	Nyabing ...	Major ...	36	7	8	12	13	76
Bryant, R. J.	Qualtrading	Royal ...	Gluyas Early	27	9	8	14	14	72
Sargent, A. McD.	Nyabing	Nyabing ...	Major ...	32	8	7	12	13	72

## ZONE 9.—Judge: L. G. Seimor, Manager, Experiment Farm, Salmon Gums.

Waters, T. ...	Dowak ...	Southern Mallee	Gluyas Early	26	9	9	10	14	68
O'Kieffe, M. ...	do. ...	do.	do.	23	9	9	12	14	67

## OBJECTS OF THE COMPETITION.

The object of the competitions is the improvement of the standard of wheat farming methods practised throughout the Wheat Belt. A spirit of healthy rivalry is engendered, and competitors and others set themselves to follow those more successful than themselves. The methods practised by all the competitors are tabulated, the good farmers of the State receive recognition of their ability, and consequently a standard of practical wheat farming is established. It is demonstrated that where recommended methods are employed, reasonable success follows. The competitions also afford the officers of the Department of Agriculture to come into personal contact with the farmers.

## SEASON.

The past season was almost ideal for wheat growing. After a dry summer the season opened with splendid early rains in March and April, which gave the weeds a good start and the opportunity for controlling them before seeding. Although May was a rather dry month, except in the Southern and Esperance areas, it permitted seeding operations to proceed uninterrupted, and the dry conditions also lent themselves admirably for weed destruction. Copious rains were general during June, and July, causing waterlogging and erosion in the wetter districts, but they assisted to carry over the crops to maturity when the late spring rains fell short of the average. The winter, on the whole, was a mild one, and the crops grew very tall. Wind injury was fairly wide spread on the lighter classes of land. Although there was a record harvest, still better yields would have been obtained had the late rains been more plentiful.

## ENTRIES.

The total number of crops eligible to compete for the Zone Championship awards was 165, compared with 156 the previous year and 114 in 1928. This number is a record for the competition.

Entries were received from fifteen district Agricultural Societies, whilst sixteen individual entries were received direct by the Royal Agricultural Society. In addition, local competitions were conducted by the Goomalling, Wickepin, and Doodlakine-Baandee Agricultural Societies, Narembeen Agricultural Bureau, Yilgarn and Karloning Primary Producers' Associations and the Bonnie Rock Settlers' Association. The Bruce Rock Agricultural Society conducted a combined fallow and crop competition. These competitions included 72 competitors who were not eligible to compete for zone awards. The Bonnie Rock and Karloning competitions were on unfallowed land. The total number of crops inspected in all competitions in 1930 was 237.

The following table shows the growth of the competition since its inception in 1921:—

Year.	No. of District Agricultural Societies competing.	No. of Competitors.	Average Yield of Competitors.	Average Yield for State.
1921	...	15	bush. 25	bush. 10.4
1922	...	32	24	8.9
1923	...	82	29	11.4
1924	...	70	31	12.8
1925	...	59	22.5	9.7
1926	...	99	24.5	12.0
1927	...	100	26.9	12.1
1928	...	114	22.5	10.1
1929	...	156	21.7	11.0
1930	...	165	27.4	12.7

District Agricultural Societies did not participate until 1923.

## YIELDS.

Since 1925 the Royal Agricultural Society has awarded a special prize of £5 5s. to the competitor who obtains the highest calculated bushel yield per acre from the competing area of 50 acres. The award this year has been made to Messrs. C. Smith & Sons of Yarding, whose competing area of the variety "Glueclub," yielded 43 bushels per acre. This yield is three bushels less than the State record established in 1929 by Mr. C. E. Cockram of Pallinup with the variety "Yandilla King," which yielded 46 bushels per acre. The winners of this prize to date are as follow:—

1925—Hebiton & Sons, Three Springs	Nabawa ...	34 bush. per acre.
1926—Cuming Bros., Carnamah	Yandilla King ...	38 " "
1927—A. W. Parkinson, Gnowangerup	Yandilla King ...	40 " "
1928—A. W. Parkinson, Gnowangerup	Yandilla King ...	40 " "
1929—C. E. Cockram, Pallinup	Yandilla King ...	46 " "
1930—C. Smith & Sons, Yarding	Glueclub ...	43 " "

This year no less than 119 crops were calculated to yield 25 bushels or over per acre. Sixty-one competitors obtained yields of 30 bushels and over, and 18 yields of 35 bushels and over. Those competitors obtaining 30 bushels or over per acre are tabulated below:—

## 50-ACRE CROP COMPETITION, 1930.

*Leading Competitors for Special Prizes awarded annually by Royal Agricultural Society for Highest Bushel Yield in any Zone.*

Zone.	Competitor.	District.	Society.	Variety.	Calculated Yield per acre.
5	Smith, C. & Sons	Yardling	Bruce Rock	Glueclub	43 bush.
5	Teasdale, H. W.	Totadgin	Merredin	Nabawa	39
5	Ellis, E. G.	Cent. Kumbinuin	Bruce Rock	Glueclub	39
5	Cook, W. T.	S. Walgoolan	Merredin	Nabawa	38
5	Strange, P. A.	Yardling	Bruce Rock	Glueclub	38
5	Smith, C. & A. H.	Yalbarrin	Bruce Rock	Glueclub	38
8	White, R. H.	Gnowangerup	Gnowangerup	Yandilla King	38
7	Henderson, J. H.	Guerning	Kulin	Queen Fan	37
8	Barnard, C. E.	Gnowangerup	Gnowangerup	Yandilla King	37
5	Strachan, W.	Yardling	Bruce Rock	Glueclub	36
8	Slee, E. J. W.	Nyabing	Nyabing	Major	36
1	Bothe, B. D.	Coorow	Royal	Nabawa	35
3	Mt. Rupert Co.	Wongan Hills	Wongan Hills	Merredin	35
5	Parrall, F. C. & Sons	Yardling	Bruce Rock	Glueclub	35
5	Merredin Meat Co.	Merredin	Merredin	Canberra	35
5	Maugham, J. D.	S. Walgoolan	Merredin	Gluyas Late	35
7	Coad, H. J.	Lake Grace	Lake Grace	Nabawa	35
8	McDonald, J.	Gnowangerup	Gnowangerup	Nabawa	35
5	Teasdale Bros.	Belka	Merredin	Nabawa	34
5	Walder, L. S.	Merredin	Merredin	Merredin	34
8	Stewart, W. B.	Gnowangerup	Gnowangerup	Yandilla King	34
2	Sutcliffe, J. G.	Damboring	Dalwallinu	Glueclub	33
7	Bowey & Baldock	Kulin	Kulin	Ford	33
7	Collinson & Fleay	Lake Grace	Lake Grace	Gluyas Late	33
8	Richards, T.	S. Caroling	Royal	Nabawa	33
1	Morcombe, P. T.	Coorow	Royal	Felix	32
2	Roberts, J. A.	Moora	Royal	Nizam	32
3	Rutcher, A. F.	Pithara	Dalwallinu	Glueclub	32
3	Glenvar Pastoral Co.	Wongan Hills	Wongan Hills	Nabawa	32
3	Williams G.	Hindmarsh	Dowerin	Waratah	32
3	Cosh, E. C.	Minnivale	Dowerin	Waratah	32
3	Lane Bros.	Wongan Hills	Wongan Hills	Ford	32
7	Fowler, G. F.	Wongan Hills	Wongan Hills	Baroota Wonder	32
7	Bowey, P. J.	Kulin	Kulin	Ford	32
7	Hidlin, E. J.	Karlgrin	Karlgrin	Gluyas Early	32
8	Formby, R. & Co., Ltd.	Gnowangerup	Gnowangerup	Yandilla King	32
8	Sargent, A. McD.	Boongadon	Nyabing	Major	32
1	Hobiton, J. K.	Three Springs	Three Springs	Nabawa	31
3	Jones, W. W.	Cowowing	Wyalkatchem	Nabawa	31
3	Fordham, N. A.	Calcearra	Royal	Waratah	31
3	Lehman, C. E.	Cowowing	Wyalkatchem	Glueclub	31
3	Hodgson, H.	N. Korrolocking	Wyalkatchem	Merredin	31
3	Ackland, J. H.	Wongan Hills	Wongan Hills	Nabawa	31
4	Watson Bros.	Nungarin	Nungarin	Carrabin	31
5	Thyne Bros.	Norpa	Merredin	Merredin	31
7	Lewis, R. H.	Kulin	Kulin	Ford	31
7	Bishop, H. J.	Lake Grace	Lake Grace	Nabawa	31
7	Woodburn, J.	Lake Grace	Lake Grace	Yandilla King	31
7	Fry, E. H.	Lake Grace	Lake Grace	Gluyas Early	31
8	Taylor, C.	Pallinup	Gnowangerup	Yandilla King	31
2	Locke, F. C.	Dalwallinu	Dalwallinu	Merredin	30
3	Martin, K. J.	Dalwallinu	Dalwallinu	Ford	30
3	Bear, H. E.	Minnivale	Dowerin	Canberra	30
4	Mannell, C. J.	Munkinbun	Nungarin	Gluyas Early	30
4	Johnson, J. H.	Mangowine	Nungarin	Gluyas Early	30
7	Nichols, R.	Kulin	Kulin	Gluyas Early	30
7	Parker, C. W.	Kulin	Kulin	Merredin	30
7	Trotter, A. W.	Kulin	Kulin	Bona	30
8	Whyatt, C. A.	Pallinup	Gnowangerup	Yandilla King	30
8	Johnston, A.	Gnowangerup	Gnowangerup	Nabawa	30
8	Murray, W. G.	Borden	Gnowangerup	Yandilla King	30

In 1929 the number of competitors with yields of 25 bushels and over was 50, and in the previous year 33. The average calculated yield for all crops inspected was 27.4 bushels per acre, as against an average of 21.7 bushels the pre-

vious year. This yield has been exceeded only on two occasions previously, namely, in 1923 and 1924, when the averages were respectively 29 and 31 bushels per acre.

The following table shows the comparison between the yields for the 1930-31 season, and the previous three years:—

Zone.	No. of Competitors. 1930.	Average Calculated Yields			
		1930.	1929.	1928.	1927.
1 ...	9	28·2	24·7	29·0	28·0
2 ...	10	27·6	22·5	19·3	22·4
3 ...	31	27·5	23·4	21·3	25·6
4 ...	21	26·1	18·2	18·3	29·2
5 ...	20	32·7	21·9	20·4	26·2
7 ...	30	28·6	22·0	23·0	25·6
8 ...	21	30·0	32·2	31·0	32·0
9 ...	23	19·8	14·5	...	...
	165	27·4*	20·7	22·5	26·9

\* The results for 1929 included a number of local competitions planted on fallowed land. There were 156 competitors in the Royal and District Competitions that year—the average being 21·7 bus. per acre.

It is to be hoped that the efforts of those who carefully prepared their land, and who harvested good returns therefrom, will stimulate others to do likewise. It must be remembered, however, that the test of efficient farming comes when our season is least favourable. It is then that sound methods prove their value.

### FALLOWING.

The conditions of the competition required the crops to be sown on fallowed land. In the preparation of the fallows most of the competitors ploughed their land during the winter months of June to August. It has been definitely demonstrated that higher yields are obtained if the land is ploughed early in the fallowing season than when ploughed later. In this connection in an experiment conducted at the Merredin Experiment Farm for six years (1924-1929), the average yield of plots ploughed the first week in June was 3 bushels 51 lbs. more than those ploughed the last week in August.

The average depth of the initial ploughing was from three to four inches, mouldboard and disc ploughs being used for this operation, while in a few cases rigidtyne scarifiers and springtyne cultivators were utilised for the initial cultural operation. The advantages of using a particular type of implement is determined by the type and condition of the soil to be dealt with. Whether the disc or mouldboard be selected, it is essential that the work be done thoroughly.

For the subsequent working of the fallow in preparation of a seedbed, the springtyne cultivator was the implement chiefly used. A disc implement was favoured, however, when the ground was hard or weedy. The rigidtyne cultivator is also designed for this purpose.

Sheep are becoming more numerous throughout the Wheat Belt each year, and their value in assisting to control weed growth on fallows is more widely appreciated.

### VARIETIES.

The standard midseason variety, Nabawa, still maintained its popularity and was planted by 64 of the 165 competitors. Twenty-four competitors planted Gluyas Early, and 12 Yandilla King. Merredin and Gluelub, each by 10; Ford, 8; Queen Fan and Gluyas Late, 5; Canberra, 4; Major, Bena and Waratah, 3; Gresley, Baroota Wonder, and Carrabin, 2; and Daphne, Felix, Nizam, Dollar, Pusa, Turvey, Caliph and Drof 1.

Nabawa gained the principal honours in the District Crop Competitions, winning six first prizes, three seconds, and eight thirds. Gluyas Early was placed first three times, second once, and third twice; and Gluelub twice first, three times second, and once third.

Two zone championships were won by both Gluyas Early and Gluelub, the other zone awards being evenly divided among Nabawa, Merredin, Queen Fan, and Yandilla King, with one win each.

### TIME OF SEEDING.

This is one of the most important factors for the successful production of the wheat crop. The seeding season is a comparatively short one, and as it is known that some varieties are more suitable for early planting, others for mid-season, and others for late planting, the seeding operations should be so arranged that the varieties selected are planted as near as possible to their optimum, *i.e.*, best seeding period.

The number of competitors who planted during April was 72, in May 83, and in June 9, and one in August. This shows that there has been a tendency to plant a little earlier this year than in the previous season. Eighty-two per cent. of the crops were sown by the middle of May, the later sown crops being located chiefly in the heavier rainfall districts where the seeding period is later. Of the 165 crops in the competition, 17 were late maturing wheats, 104 midseason, and 44 early. It has been demonstrated by experiments that when it is necessary, owing to the area sown, to extend the seeding period outside the month of May, it is better to plant suitable varieties in April rather than to extend the planting period into June. For further information, see the results of the Time of Seeding Experiments, published in this issue.

### RATES OF SEEDING.

The rates of seeding varied from 22 lbs. to 75 lbs. per acre. The average rate was 48.1 lbs. per acre. The majority of the competitors planted from 45-60 lbs. per acre.

Experimental results indicate that for the midseason and early districts, while the yield is not decreased by heavier rates of seeding, no advantage is gained by increasing the amount over 45 lbs. per acre. In the very early districts the lighter rates give the best results, while for the late, *i.e.*, heavy rainfall districts, heavier rates can be practised with advantage.

### RATES OF SUPERPHOSPHATE.

Superphosphate was applied by every competitor, the average rate of application being 97.3 lbs., an increase of 3.3 lbs. upon the previous year's average. The lightest and heaviest applications were 45 lbs. and 180 lbs. respectively, while the majority of the competitors used rates ranging between 80 and 100 lbs. per acre.

The rate of superphosphate has been gradually increasing in most districts. This has been partly due, no doubt, to the fact that the leading competitors who

have followed the recommendations of the Department of Agriculture, have been applying heavier dressings of superphosphate and obtained profitable results. Experiments at the various experiment farms have shown that increased yields were obtained when heavier dressings of superphosphate up to 150 lbs. were used, particularly on the lighter classes of soil.

The drastic change in the economic conditions of wheat farming, however, alters the interpretation of the results of these experiments because, where in the past liberal dressings of superphosphate were profitable, this is not so to-day.

An analysis of the results of the rate of superphosphate with wheat experiments shows that when superphosphate is valued at £5 a ton and wheat at 2s. a bushel, the limit of profitable application for the heavy forest country appears to be reached with an application of 112 lbs. per acre, and on the light land 120 lbs. per acre.

### DISEASES.

Diseases found in the competition crops were Ball, Flag and Loose Smuts, Take-all and similar diseases (Foot Rot and Root Rot) and Septoria and Rust. Frost and wind injury were also observed.

*Ball Smut.*—It is surprising to find these days evidence of this disease in competition crops. Though the number of infected crops is yearly diminishing the economic loss to farmers from this and other preventable diseases is all too large. This disease can be prevented by the use of such fungicides as dry copper carbonate powder or the bluestone or formalin solutions. All are reliable fungicides, but of these by far the most popular is the dry copper carbonate dust. When correctly applied, at the rate of  $1\frac{1}{2}$  to 2 ounces per bushel, this method is very effective in preventing the disease. An added advantage with this method is that the seed wheat can be treated and stored immediately after harvest without any detrimental effect, and in addition the copper carbonate acts as a preventative against vermin. The presence of Ball Smut in a crop nowadays is not only indicative of faulty treatment, but also of "slipshod" methods. The results with this treatment have been so highly satisfactory that where care is exercised and the seed thoroughly dusted, the disease can be entirely eliminated.

*Flag Smut.*—This disease is becoming more in evidence each year. Unlike Ball Smut, where the chief source of infection is from spores on the seed, this disease is a soil infection. Spores from various agencies find their way into the soil, and remain there to attack the wheat crops. It can be seen, therefore, that its control lies not so much from seed treatment, but more along the lines of crop rotation. As a precaution all seed should be treated with dry copper carbonate, and while there is evidence that this diminishes re-infection to a limited extent, it will not control it. The most effective means of control of this disease are by cultural methods in conjunction with the growing of resistant wheats, and it is indeed fortunate that such a popular variety as Nabawa is Flag Smut resistant, as is also the late maturing variety Yandilla King. Other resistant wheats are Beneubbin, Carrabin, and Geeralying, all of which are recommended for planting on infected areas. Gluyas Early, Merredin and Canberra, all early varieties, are very susceptible to this disease.

A certain means of spreading infection throughout the farm is by feeding infected wheaten hay to stock. Oaten hay should be used, as in addition, the growing of oats also assists in the control of the disease Take-all. Badly infested wheat stubbles should be burnt and so prevent stock spreading the spores over the farm, either through the agencies of the manure or by carrying it on their bodies. Early fallow and judicious cultivation to keep down weeds and self sown wheat plants are essential. Where it is known that a paddock is infected, it is advisable to delay seeding until after the first seeding rains.

Briefly, the methods of control are as follow:—

1. Fallow early and well.
2. Keep fallows free of weeds and self-sown wheat.
3. Plant resistant varieties.
4. Plant as late as is safe to plant in the sowing season.
5. Discontinue feeding infected hay to stock.
6. Include oats in the crop rotation.
7. Burn the stubble of infected crop.

*Loose Smut.*—Loose Smut or Flying Smut is more difficult to control, as there is no practical method of seed treatment. Seed from badly infected crops should be discarded, and fresh seed obtained from clean crops.

*Take-all.*—Take-all was more in evidence this year than in the previous season. This disease is also the result of soil infection, and its control is very similar to that for Flag Smut. There is, however, no variety, as yet, known to be resistant to this disease, and its control depends, therefore, in the farming practice adopted. In this respect the value of a crop of oats (free of barley or wheat) is of utmost importance.

It was not surprising to find that in some cases where competing crops were badly infested with Take-all, the reason was because no control methods had been taken. Farmers are advised not to wait until their cropping areas become badly infected before taking steps to control the disease, but to adopt preventative methods which include the growing of oats in their cropping rotation.

*Rust.*—This is a disease, the prevalence of which depends mainly on the seasonal conditions, over which there is no control. In districts where rust is likely to occur, farmers should avoid growing rust-labile wheats.

*Septoria.*—The disease Septoria is most liable to occur when the wheat crop is planted too early. Under these conditions there is a tendency for the plants to make flaggy and rank growth, and as a result they become more susceptible to infection by the fungus. The control consists of seasonable planting and the practice of clean farming methods.

It is not possible, in the space of this article, to discuss the various diseases fully, but should any reader desire further information concerning these diseases, bulletins are available for free distribution, and can be obtained on application. The bulletins mentioned are:—

Septoria—No. 121.

Rust of Cereals—No. 126.

Flag Smut—No. 134.

Cereal Smuts—No. 160.

Foot Rot and Root-Rot of Wheat—No. 228.

Partial or complete emptiness in wheat heads—No. 301.

Earcockle and Bacterial Diseases of Wheat—No. 196.

These 50-acre Crop Competitions have demonstrated over widely distributed centres, and on all classes of soils throughout the wheat belt, that higher yields are possible when sound methods are adopted. Other cropping competitions which deal with the average yield of the whole area cropped on the farm, such as the Wheat Yields Competition (1924-26), the Bateman Trophy Competition (1929), and the District Challenge Shield Competition (1928-30) have proved that these methods, when also applied to the whole cropped area, are more profitable.

Costs of production are the vital factors in the success of any industries. Higher average yields mean lower costs per bushel. Therefore, by the adoption of sound methods it is within the compass of every farmer to lower, to some extent, the costs of production and hence increase the margin of profit.

Herein lies the real value of crop competitions.



## FISTULOUS WITHERS—A POSSIBLE SOURCE OF DANGER TO THE DAIRY FARMER.

H. W. BENNETTS, M.V.Sc., and J. F. FILMER, B.V.Sc.

Fistulous withers and poll evil have long been recognised as extremely troublesome conditions in the horse. Their treatment generally requires several surgical operations and prolonged hospital treatment. This is usually so costly as to make it quite uneconomical, and the owner often resorts to destruction.

The cause of these complaints has been the object of a fair amount of research. Originally it was held that they were the result of injury. This is probably true of a small percentage of cases. However, so many cases occur in which the possibility of injury is very remote, that it became necessary to search for other causes.

Recent work along these lines has revealed a possible cause, which has a rather startling significance. It is fairly generally known that Contagious Abortion in cattle is due to a germ, and that the presence of this germ may be detected by a blood test known as the agglutination test. In 1928 this test was applied by two French veterinarians to fifteen horses suffering from fistulous withers or poll evil. Of these, twelve blood samples gave positive reactions. It was further noted that in all of the positive cases the horses came from farms where Contagious Abortion was present amongst the cattle. In two cases it was definitely established that the germs of Contagious Abortion were being given off in the discharges. There was some evidence that this was happening in several other cases.

In 1929 this investigation was repeated in America. Out of forty-six cases, thirty-nine gave positive blood tests. In ten of these cases the pus was examined, and in three cases the germ of Contagious Abortion was found to be present.

When this work was brought to the notice of the writers it was decided to investigate the position in Western Australia. So far only two cases have been examined. One of these was an old case of fistulous withers discharging from both sides. The other case was of the type sometimes known as a "Blackboy fistula." A large swelling had formed on the withers and subsided without bursting. A swelling then appeared on the poll, and later, burst.

The significance to the dairy farmer of this new discovery is readily apparent. The spread of Contagious Abortion has been shown to occur through cows eating pasture contaminated by the germ of the disease. If then this germ is present in the discharges from fistulous withers and poll evils, these must be treated as infectious diseases.

It is not suggested that all such cases are due to the germ of Contagious Abortion, but dairy farmers should err on the safe side. All such cases should be isolated so that there is no possibility of the discharges contaminating the food of cows.

The Veterinary Pathologist of the Department of Agriculture will be pleased to receive samples of blood serum from cases of fistulous wither or poll evil. Blood may be obtained by severing a small artery in the ear or by puncturing the jugular vein in the neck. It should be collected in a clean bottle which has been boiled. About four tablespoonsful of blood is sufficient. This should be allowed to stand for twelve hours, and the clear straw-coloured serum should then be poured off into another clean bottle and forwarded immediately.

Further work will be carried out as occasion offers. The present results are being published at this early stage of the investigation in order that dairy farmers may take the precautions which appear to be necessary.

## LOCAL CROP COMPETITIONS.

I. THOMAS, Superintendent of Wheat Farms.

In addition to the 50-acre Crop Competitions conducted by the Royal and District Agricultural Societies, competitions were also conducted by unaffiliated bodies or by Agricultural Societies who submitted their entries too late for acceptance by the Royal Agricultural Society. Some of these competitions were judged under different conditions from those under which the Royal and District Competitions were conducted, inasmuch that it was not necessary for the crops to be on fallowed land. Although this may seem to be a departure from the policy of giving encouragement to sound farming methods, it must be understood that most of these competitions were conducted in newly settled areas under pioneering conditions where little or no fallowed land had yet been prepared.

The value of having crop competitions in the early stages of settlement is a very potent one inasmuch as it affords a departmental officer the opportunity of visiting the settlers and after inspecting the crops, giving them advice as to improvement of their methods. By creating an atmosphere of friendly rivalry and by focussing attention to good methods, in the early stages, much more rapid improvement can be expected from these newly settled areas.

It must be pointed out, however, that, providing a competitor can fulfil the requirements laid down by the Royal Agricultural Society, namely, that the crop is sown on fallowed land and consists of one variety of at least 50 acres in area, he is not debarred from competing for the substantial Zone prizes available. The Zones into which the wheat belt is divided are so arranged that competitors farming in areas of similar rainfall, climatic and soil conditions, compete with one another and hence all have the same advantage.

This year local crop competitions were conducted by the following bodies:—Goomalling Wickepin and Doodlakine-Baandee Agricultural Societies (whose entries were made too late to be eligible for the Royal Competition), the Narembeen Agricultural Bureau, the Yilgarn and Karloning Primary Producers' Associations and the Bonnie Rock Settlers' Association. In addition the Bruce Rock Agricultural Society conducted a combined Fallow and Crop Competition.

In all there were 72 entries, the average yield for all competitors being 23.4 bushels per acre. The Bonnie Rock and Karloning Competitions were on unfallowed land, the averages for the competitors on fallowed and unfallowed land being as follows:—

				Average Yield per acre.
				Bus.
Fallowed (45 competitors)	..	..	..	26.6
Not fallowed (27 competitors)	..	..	..	18.0
Average				23.4

The judges' reports and awards, together with a detailed summary of the cultural details will be found on the following pages.

## DOODLAKINE-BAANDEE AGRICULTURAL SOCIETY.

I. THOMAS, Superintendent of Wheat Farms.

This Society is located in Zone 5, but the entries were received too late by the Royal Agricultural Society to be included in the Zone Competition.

Eight competing areas were submitted for inspection and the awards made are hereunder:—

## DOODLAKINE-BAANDEE AGRICULTURAL SOCIETY.

Judge: I. Thomas, Superintendent of Wheat Farms.

Name.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admix- ture.	Even- ness of Growth.	Total.
			50 points	10 points	10 points	15 points	15 points	100 points
Arthur, E. J. ...	Baandee ...	Gluyas Early	33	8	8	14	14	77
Stevens, P. T. ...	Doodlakine	Nabawa	30	9	9	13	14	75
Prowse Bros. ...	do. ...	Gluyas Early	31	8	8	14	13	74
Harrison, T. H. ...	do. ...	Carrabin	29	8	8	11	14	70
Mablesen, H. H. ...	Baandee ...	Nabawa	27	9	8	13	13	70
Prowse, A. E. C. ...	Doodlakine	do.	26	8	8	14	14	70
Prowse, Edgar ...	do. ...	do.	25	8	7	13	13	66
Kay, J. ...	Baandee ...	Gluyas Early	26	7	7	13	13	66

The winning crop was a very attractive one of the variety Gluyas Early, and was part of 220 acres of the same variety which, from a casual inspection, was similar to the area submitted for inspection. Planted the last week in April with 45lbs. of graded pickled seed with 70 lbs. of superphosphate per acre, it had made strong growth and was fairly regular in height and stooling. It was also fairly free of admixture and weeds. A trace of the disease Flag Smut was present.

The 50 acres of the variety Nabawa, submitted for inspection by Mr. P. T. Stevens, was also an attractive exhibit. Very few weeds were present, and with the exception of Septoria on the foliage no disease was noted. There was, however, an occasional plant of barley, but the crop was very even in height and had stooled well. It had been planted with 60 lbs. re-cleaned seed which had been treated for the prevention of Ball Smut, together with an application of 60 lbs. of superphosphate per acre.

The rainfalls for Doodlakine and Baandee respectively are as follow:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	Jun.	July.	Aug.	Sep.	Oct.	Total.			
Doodlakine ...	...	100	76	245	44	317	197	194	69	22	843	2	65	1,331
Baandee ...	...	...	165	220	58	295	155	107	54	12	771	...	22	1,178

The cultural details of the competitors are summarised in the following table:—

CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed	Implement	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Arthur, E. J.	Fallow, crop, pasture	Salmon, gimlet, and morrel	June	Disc cultivating	in. 3	Good	Harrowed twice immediately after ploughing; springtype cultivated Sept.; Harrowed March; springtype cultivated fortnight later	Gilvys Early	Last week April	lb. 45	lb. 70	Copper carbamate	Yes	Trace Smut Flag
terens, P. L.	Old Land	Salmon and gimlet	June-July	Mould-board	3½	Good	Harrowed after ploughing then cultivated Oct. and sown again Sept. and before planting. Harrowed after seedling	Nabawa	2nd week May	60	60	Copper carbamate	Re-cleaned	Septoria
Prowse Bros.	Part at least 13 years before 4th crop	Salmon, gimlet and jam	June	Mould-board	3½	Good	Springtype cultivated Sept. Sheep running on fallow. Planted with combined cultivator drill	Gilvys	Last week April	45	100	Copper carbamate	Yes	Traces Smut and Takeall
Harrison, T. H.	3 years (Fallow, crop pasture)	Gimlet, salmon and morrel	June-July	Mould-board	4	Good	Springtype cultivated Sept. Skim ploughed, planted with combined cultivator drill	Carrollin	2nd week May	60	75	Copper carbamate	Re-cleaned	Flag Smut
ableson, H. & H.	4th year cropped, 2 year rotation	Salmon and gimlet	July	Mould-board	3	Good	Cultivated with rigid type implement Sept. Springtype cultivated November and March	Nabawa	1st week May	45	90	Copper carbamate	Yes	Takeall
Prowse, A. E. & C.	Fallow and crop	Salmon and gimlet	Late June	Mould-board	3½	Good	Springtype cultivated Sept. Seeded with combined cultivator drill	Nabawa	Middle April ...	45	100	Copper carbamate	Yes	Takeall
Prowse, E. ...	Fallow and crop 10 yrs. 2 years pasture prior last fallow	Salmon, gimlet, boree and jam scrub	Early July	Disc	3½	Good	Springtype cultivated early October. Planted with combined cultivator drill and harrowed immediately after	Nabawa	Last week April	37	90	Copper carbamate	Yes	Septoria, Takeall

CULTURAL DETAILS—*continued*.

Competitor.	No. years cropped.	Timber.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Kay. J ...	Oats, fallow, wheat, wheat	Salmon, gumlet, marlet and tea tree	July	Mould-board	in. 3½	Good	Springtine cultivated Sept. and Nov., followed by a harrow. Disc cultivated and rigid type cultivated prior to seeding. Planted with disc drill	Guyas Early	4th week May	lb. 45	lb. 90	Copper carbamate	Yes	Traces Take-all and Flag Smut

## GOOMALLING AGRICULTURAL SOCIETY.

Judge: A. S. WILD, B.Sc. (Agric.), Agricultural Adviser.

Only three crops were submitted for inspection in the competition conducted by the Goomalling Agricultural Society. The awards were made as hereunder:—

## GOOMALLING AGRICULTURAL SOCIETY.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

Competitor.	District.	Variety.	Yield, 50 pts.	Free- dom from weeds, 10 pts.	Free- dom from disease, 10 pts.	Free- dom from admix- ture, 15 pts.	Even- ness of growth, 15 pts.	Total, 100 pts.
Johnson, F. B. ...	Burabadji ...	Ford ...	33	9	8	13	13	76
Miller, J. F. ...	Oak Park ...	Ford ...	30	9	8	14	14	75
Lord, F. J. ...	Burabadji ...	Ford ...	30	9	9	13	13	74

All the competing areas were of the variety Ford.

Mr. F. B. Johnson, of Burabadji, who secured first place, had prepared his land (old jam, york gum, and salmon gum country) by ploughing to a depth of 4½ inches with a mouldboard plough during July, 1929. This was followed by a springtyne cultivation in September, a cross-harrowing in October, and a further springtyne cultivation in March and again just before seeding. The crop was planted during the first week in May, 70 lbs. of pickled, graded seed being sown per acre, together with 80 lbs. of superphosphate. The crop, a comparatively tall one, was calculated to yield 33 bushels per acre.

The rainfall recorded at Goomalling is as follows:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Goomalling, 1930 ...	...	2	89	112	54	323	292	225	112	22	1,028	7	57	1,125

The cultural details of all three competitors are summarised hereunder:—

CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed	Condition of land.	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Johnson, F. B.	Old land	Jam, yorke-gum and salmon	July	Excellent	Mould-board	in. 4½	Springtyne cultivated in Sept.; cross harrowed Oct.; springtyne cultivated March and before seeding	Ford	1st week May...	lb. 70	lb. 80	Copper carbonate	Yes	Traces of Ball smut and Takeall
Miller, J. F. ...	4	Mallee, salmon, jam and yorke-gum	Late July	Excellent	Mould-board	3½	Springtyne cultivated Sept.; harrowed before seeding	Ford	3rd week April	50	96	Copper carbonate	Yes	Traces of Takeall and Septoria
Lord, F. J. ...	5	Jam, gimlet and salmon	July and Aug.	Good	Mould-board	4	Springtyne cultivated Sept. and before seeding	Ford	End April ...	60	90 2½%	Copper carbonate	Yes	Trace of Takeall

## WICKEPIN AGRICULTURAL SOCIETY.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

Although only four crops were inspected for the competition conducted by the Wickepin Agricultural Society, some high yields were recorded.

The awards made are set out below:—

## WICKEPIN AGRICULTURAL SOCIETY.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

Competitor.	District.	Variety.	Yield. 50 pts.	Free- dom from weeds, 10 pts.	Free- dom from disease, 10 pts.	Free- dom from admix- ture, 15 pts.	Even- ness of growth, 15 pts.	Total, 100 pts.
Elliot Bros. ...	Gillinmanning ...	Gallipoli ...	37	9	8	13	14	81
Clifford, T. ...	Gillinmanning ...	Gallipoli ...	34	9	8	12	12	75
Phoebe, J. C.	Dorakin ...	Free Gallipoli	25	9	8	13	12	67
Hosken Bros.	Dorakin ...	Canberra ...	21	9	8	14	14	66

The crops both of Messrs. Elliot Bros. and Mr. T. Clifford were of the variety Gallipoli, the former being calculated to yield 37 bushels, and the latter 34 bushels per acre. The winning crop had been planted during the third week in April at the rate of 54 lbs. of re-cleaned seed per acre, together with 80 lbs. of superphosphate. It was very even in growth and free of weeds, but contained traces of Takeall and Flying Smut, and also lost points for admixture in the form of barley and odd heads of "strange" varieties of wheat.

The rainfall recorded at Wickepin is shown hereunder:—

---	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Wickepin, 1930 ...	...	52	118	125	47	504	585	162	124	15	1,437	...	20	1,752



The cultural details of the competing crops are tabulated hereunder:—

CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed	Condition of land.	Implement	Depth.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Elliott Bros....	1	Yorkgum & Jam	July	Good	Mould-board	in. 3	Springtyme cultivated once before seeding. Planted with combined cultivator drill	Gallipoli	3rd week April	lb. 54	lb. 80	No	...	Traces of Take-all and Flying Smut
Clifford, T. ...	2	Jam manna and Yorkgum	July	Fair	Mould-board	4½	Springtyme cultivated once. Planted with combined cultivator drill	Gallipoli	End April	60	115	Copper carbonate	Yes	Traces Takeall and Smut
Phoebe, J. C.	3	Whitegum and morrel	July	Excellent	Mould-board	4	Portion springtyme cultivated Sept. and remainder Nov.; mould-board ploughed 3in. deep before seeding. Planted with combined cultivator drill	Canberra Gallipoli	Mid-April	60	90	Copper carbonate	Yes	Takeall patches
Hosken Bros.	Old land	Morrel and mallee	July	Good	Mould-board	4	Springtyme cultivated Sept and Apl. Planted with combined cultivator drill	Canberra	Early May	70	112	Formalin	Yes	Traces of Take-all, Flying Smut and Flag Smut

## NAREMBEEN AGRICULTURAL BUREAU.

Judge: N. DAVENPORT, B.Sc. (Agric.), Agricultural Adviser.

The above Society organised a 50-acre crop competition in conjunction with a fallow competition conducted the previous autumn. The crop competition was purely a local one and was not connected with the State-wide competition sponsored by the Royal Agricultural Society.

The season experienced was a good one, as is borne out to some extent by the monthly rainfall registrations given below:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Narembreen, 1930 ...	...	3	180	153	72	288	302	206	117	28	1,013	...	20	1,369

Most of the crops were more or less affected with the disease Takeall. The prevalence of this disease in the district shows the necessity for improvement in the cropping practice of disease control. Reference to the control of this disease is made on page 85.

The winning crop, that of Mr. H. Hebbeman, was of the variety Ford which, although showing a rather excessive growth of straw, was well headed and its evenness of growth added to its attractive appearance. The presence of the disease Flag Smut was noticed.

The tables showing the points awarded and the cultural details of the respective competitors are given below:—

## NAREMBEEN AGRICULTURAL BUREAU.

Judge: N. Davenport, B.Sc. (Agric.), Agricultural Adviser.

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 points	10 points	10 points	15 points	15 points	100 points
Hebbeman, H. ...	Emu Hill ...	Ford ...	30	9	8	12	13	72
Burgin & Yoeman	Narembreen	Nabawa	26	7	8	13	12	66
Dayman, G. S. ...	do. ...	do. ...	26	7	7	12	12	64
Howell, A. ...	do. ...	Waratah	26	7	7	12	11	63
Price, J. H. ...	do. ...	Nabawa	24	8	6	11	11	60
Cavanagh, F. O....	Emu Hill ...	do. ...	20	8	7	13	12	60
McConnell, Mrs. I. H.	Narembreen	Waratah	20	6	7	13	12	58

## CULTURAL DETAILS.

Competitor.	No. of years cropped.	Timber.	When ploughed.	Implement	Depth	Condition of land.	Subs. (unt cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
He'berman, H.	Old land	Salmon, gimlet and mallee	June	Mould-board	in. 2½	Good	Disc cultivated Aug.; springtype cultivated Sept. Planted with combined cultivator drill	Ford	1st week May...	58	90	Copper carbonate	Yes	Takeall and Ball Smut
Burgin and Yeoman	Old land	Salmon, gimlet, mallee and morret	July	Scarifier	4	Good	Rigid-type scarified Sept. and March and before seeding. Planted with a disc drill	Nabawa	Last week April	40	55	Copper carbonate	Yes	Traces Ball and loose Smut and Takeall
Dayman, G. S.	5	Salmon, gimlet and mallee	June-July	Disc	4	Good	Cross disc. Aug.; springtype cultivated end of Sept. and again ahead of the ho-drill	Nabawa	2nd week May...	52	90	Copper carbonate	Yes	Takeall and Ball Smut
Howell, A. ...	3	Salmon, gimlet, mallee and morret	June	Mould-board	4	Good	Springtype cultivated Sept.; rigid-type scarified Oct.; cultivated prior to drilling with a disc drill	Waratah	2nd week May...	60	120	Copper carbonate	Yes	Flag Smut, Takeall, little loose Smut
Price, J. H. ...	3	Salmon, gimlet and mallee	June-July	Disc	3	Good	Cross disc cultivated Aug.; harrowed Sept.; springtype cultivated after rain early Nov. and during first week May. Seeded with combined cultivator drill	Nabawa	2nd week May...	50	90	Formalin	Yes	Takeall and trace Ball Smut
Cavanagh, F. O.	6	Salmon and gimlet	July	Mould-board	4	Fair	Cultivated with disc implement; July; springtype cultivated in Sept. and prior to seeding	Nabawa	1st week May ...	45	90	Copper carbonate	Yes	Takeall
McConnell, Mrs. I. H.	5	Salmon and gimlet	Oct.	Disc	2	Rather dry	Springtype cultivated after rain in March and before drilling with a disc implement	Waratah	1st week May ...	58	90	Copper carbonate	Re-cleaned	Flag Smut, Takeall, and loose Smut

## KARLONING PRIMARY PRODUCERS' ASSOCIATION.

Judge: N. DAVENPORT. B.Sc. (Agric.), Agricultural Adviser.

The above Association again conducted a 50-acre crop competition this year for further competition for the cup presented by Mr. John Driver.

The awards made are shown in the table hereunder:—

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 points	10 points	10 points	15 points	15 points	100 points
Hewitt, B. G. ...	Karlning ...	Gluyas Early ...	23	8	9	13	14	67
Blight, L. R. ...	do. ...	do. ...	23	9	8	12	14	66
Driver, F. A. ...	do. ...	do. ...	18	9	8	14	13	63
Watkins, Mrs. O. I. ...	do. ...	Nabawa ...	21	8	9	11	12	61
Bell, G. ...	do. ...	Gluyas Early ...	18	8	9	12	13	60
Borlace, J. ...	do. ...	do. ...	17	9	9	12	13	60
Driver, H. ...	do. ...	Nabawa ...	16	9	9	14	12	60
McInnes, P. ...	do. ...	Gluyas Early ...	19	8	9	11	13	60
O'Neill, H. ...	do. ...	Nabawa ...	17	9	9	13	12	60
O'Neill, J. ...	do. ...	do. ...	16	8	9	14	12	59
Seaby, H. ...	do. ...	Gluyas Early ...	18	8	8	12	12	58
Hewitt, E. E. ...	do. ...	do. ...	14	9	9	13	12	57
Johnson, H. T. ...	do. ...	do. ...	17	9	8	11	12	57
Broomhall, V. ...	do. ...	Nabawa ...	15	9	9	11	11	55

Under the rules of the competition crops grown both on fallowed and unfallowed land are eligible to compete. The fact that the first and second prize winners were the only crops grown on fallowed land demonstrates the value of cropping on fallowed land.

In a new district this is, of course, often difficult to effect, and where land is continuously cropped advantage should be taken of any summer rains to break up the soil to a shallow depth in readiness for seeding.

In general, the yields of the competitors were fairly even, as weeds have not yet become plentiful, nor is disease very evident. Admixture is fairly common, and is mainly due to self-sown wheat from the previous crop.

The winning crop of the variety Gluyas Early, entered by Mr. B. G. Hewitt, was grown on land ploughed in June and planted during the third week in April. It was one of the most even crops entered in the competition and was well headed.

The rainfall recorded at Karlning is as follows:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Karlning, 1930 ...	...	...	88	277	38	409	137	101	68	15	828	9	127	1,329

The cultural details have been summarised in the following table:—

CULTURAL DETAILS.

Competitor.	Years cropped.	Timber.	Subsequent cultivations.	Variety.	Planted.	Rate of Seed.	Rate of Super.	Seed Treatment.	Graded.	Disease.
Hewitt, B. G. ...	2nd year	Salmon and gimlet ...	Disc ploughed mid-June 3in. springtine cultivated August; harrowed Nov.; seeded with combined cultivator drill	Gluyas Early ...	3rd week April	30	60	Copper carbonate	Yes	
Blight, L. R. ...	4th year	Salmon and gimlet	Disc ploughed 2 1/2 in. - 3 in. July; springtine cultivated August and March; Seeded with combined cultivator drill	Gluyas Early ...	2nd week May	35	75	Copper carbonate	Yes	Ball smut
Driver, F. A. ...	1st year	Salmon and gimlet	Planted with combined cultivator drill	Gluyas Early ...	3rd week May	35	70	Copper carbonate	Yes	Frost injury
Watkins, Mrs. O. I.	1st year	Salmon and gimlet	Seeded with combined cultivator drill ...	Nabawa ...	4th week April	30	44	Copper carbonate	Yes	
Bell, G. ...	1st and 2nd year	Salmon and gimlet	Seeded with combined cultivator drill	Gluyas Early ...	1st week May	39	60	Copper carbonate	Yes	
Borlace, J. ...	2nd year	Salmon and gimlet ...	Cultivated week prior to seeding; seeded with combined cultivator drill	Gluyas Early ...	2nd week May	39	63	Copper carbonate	Recleaned	
Driver, H. ...	1st year	Salmon and gimlet	Springtine cultivated week previous to seeding; planted with disc drill	Nabawa ...	3rd week April	30	60	Copper carbonate	Yes	Frost injury
McInnes, P. ...	3rd year	Salmon and gimlet	Springtine cultivated March; seeded with combined cultivator drill	Gluyas Early ...	1st week May	36	60	Copper carbonate	Yes	
O'Neill, H. ...	1st year	Mallee, jam and tea-tree	Seeded with combined cultivator drill ...	Nabawa ...	1st week May	36	60	Copper carbonate	Recleaned	
O'Neill, J. ...	1st year	Salmon, and gimlet, mallee and scrub	Springtine cultivated end Oct. and March after rain; planted with disc drill	Nabawa ...	3rd week April	30	50	Copper carbonate	Yes	Frost injury
Seaby, H. ...	3 yrs. continuously	Salmon, gimlet, and mallee	Seeded with combined cultivator drill ...	Gluyas Early ...	1st week May	36	45	Copper carbonate	Yes	Ball smut
Hewitt, E. E. ...	1st year	Mallee, tea-tree, light scrub	Seeded with disc drill ...	Gluyas Early ...	2nd week April	40	60	Copper carbonate	Yes	Little Septoria
Johnson, H. T.	1st year	Salmon and gimlet, little white gum and scrub	Seeded with combined cultivator drill ...	Gluyas Early ...	2nd week May	30	70	Copper carbonate	Yes	Frost injury
Broomhall, V. ...	1st year	Salmon, gimlet, mallee and jam	Seeded with combined cultivator drill ...	Nabawa ...	3rd week April	36	55	Copper carbonate	Recleaned	Frost injury

# BONNIE ROCK SETTLERS' ASSOCIATION.

Judge: N. DAVENPORT, B.Sc. (Agric.), Agricultural Adviser.

The settlers of this district, which is situated about 40 miles North-East of Mukinbudin, are to be commended for their enthusiasm in organising a competition of this nature, especially so as this is the first year of general cropping in the district.

Of the thirteen entries one crop only was planted on fallow. The fact that this crop, entered by Mr. H. Baber won the competition demonstrates the advantage of fallow over non-fallow. This crop, comprising areas of Gluyas Early and Nabawa, was well grown, although the Nabawa section was rather uneven, weeds and disease were practically absent.

The awards are as follow:—

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admix- ture.	Even- ness of Growth.	Total.
			50 points	10 points	10 points	15 points	15 points	100 points
Baber, H. ...	Bonnie Rock	Gluyas Early	23	9	9	13	12	66
Edmeads, G. ...	do. ...	do. ...	21	9	9	12	12	63
Fuss, K. ...	do. ...	do. ...	19	9	9	13	12	62
Machinson, A. ...	do. ...	Nabawa ...	19	9	9	13	12	62
Terry Bros. ...	do. ...	do. ...	18	9	9	13	12	61
Atherton, A. ...	do. ...	do. ...	17	9	9	13	12	60
Caunt, F. W. ...	do. ...	Gluyas Early	19	9	9	11	12	60
Driver, A. ...	do. ...	do. ...	18	9	9	12	12	60
Macham, J. ...	do. ...	Noongaar ...	17	9	9	13	12	60
Jackman & Wood	do. ...	Gluyas Early	15	9	9	13	12	58
Calder & Johnson	do. ...	do. ...	17	9	8	12	11	57
Sprigg, W. F. ...	do. ...	do. ...	17	9	9	11	11	57
Pollard & Naylor	do. ...	do. ...	15	9	6	11	11	52

As would be expected from the first year cropping on such country, the crops were generally very similar. Weeds and disease were very little in evidence.

The seed used was in most cases rather impure, barley being an especially objectionable admixture.

The rainfall for Bonnie Rock was as follows:—

---	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Bonnie Rock, 1930	...	20	171	273	35	261	167	149	64	14	690	...	57	1,211

The cultural details have been summarised in the following table:—

## CULTURAL DETAILS.

Competitor.	Years Cropped.	Timber.	Subsequent Cultivations.	Variety.	Planted.	Rate of Seed.	Rate of Super.	Seed Treatment.	Graded.	Disease.
Baber, H. ...	1st year	Mallee scrub and bullock	Ploughed with light disc plough 3in. deep June; disc cultivated prior to seeding with a disc drill	Guyas Early and Nabawa	2nd week April	lb. 41	lb. 120	Copper carbonate	Yes	
Edmonds, G. ...	1st year	Salmon, gimlet, jam and mallee	Seeded with combined cultivator drill ...	Guyas Early...	2nd week April	30	50	Copper carbonate	Yes	
Fuss, K. ...	1st year	Salmon, gimlet and mallee	Ploughed with light disc plough 2in.-3in. deep. March. Seeded with combined cultivator drill	Guyas Early...	2nd week May	32	55	Copper carbonate	Yes	
MacIntosh, A. ...	1st year	Salmon, gimlet and mallee	Ploughed with light disc plough early March. Seeded with combined cultivator drill	Nabawa and Guyas Early	1st week May	35	45	Copper carbonate	Yes	
Terry Bros. ...	1st year	Mallee ...	Seeded with combined cultivator drill ...	Nabawa ...	3rd week April	35	60	Copper carbonate	Recleaned	
Atherton, A. ...	1st year	Mallee, jam and tea-tree	Seeded with combined cultivator drill ...	Nabawa ...	3rd week April	34	70	Copper carbonate	Yes	
Cant, F. W. ...	1st year	Salmon and gimlet	Springtyne cultivated and cross seeded with combined cultivator drill	Guyas Early...	1st week May	35	55	Copper carbonate	Yes	
Driver, A. ...	1st year	Salmon, gimlet, mallee and jam	Seeded with combined cultivator drill ...	Guyas Early...	Last week April	32	60	Copper carbonate	No	
Macham, J. ...	1st year	Mallee and scrub ...	Seeded with a combined cultivator drill ...	Noongar ...	Last week May	30	60	Copper carbonate	Yes	
Jackman & Wood	1st year	Salmon and gimlet	Seeded with combined cultivator drill ...	Guyas Early...	1st week May	29	80	Copper carbonate	Yes	
Calder and Johnson	1st year	Salmon and gimlet...	Seeded with combined cultivator drill ...	Guyas Early...	Last week May	40	60	Copper carbonate	Yes	Ball Smut,
Strigg, W. L.	1st year	Salmon, gimlet, tea-tree and jam	Ploughed with mouldboard 2in. deep during March. Seeded with combined cultivator drill	Guyas Early...	3rd week April	40	40	Copper carbonate	Yes	
Pollard & Naylor	1st year	Light, mallee and scrub.	Seeded with combined cultivator drill ...	Guyas Early...	1st week May	30	60	Copper carbonate	Yes	Ball Smut

## YILGARN PRIMARY PRODUCERS' ASSOCIATION.

Judge: G. L. THROSELL, Dipl. Agric., Agricultural Adviser.

Seventeen crops were submitted for judging in this competition this year, three more than in the previous year, when two competitions were conducted—one for crops on fallowed land and the other on unfallowed land. This year, however, the competition was restricted to fallowed land only. It was surprising that so few entries were received from the Moorine Rock area, where interest in the competition was very keen last season.

The rainfall recorded at the different centres is as follows:—

---	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Turkey Hill ...	...	...	45	228	150	278	101	153	46	...	728	4	201	1,206
Southern Cross ...	...	200	89	275	106	267	92	121	50	8	644	16	...	1,224
Bullfinch ...	...	3	73	225	119	290	124	191	52	17	793	34	...	1,128
Corinthian ...	...	4	55	191	90	347	126	155	55	23	796	30	77	1,153
Moorine Rock ...	...	21	102	262	109	396	175	180	79	14	953	21	135	1,494

The winner was Mr. R. Teale, of Turkey Hill, whose crop of Nabawa was awarded 76 points. This was a tall and very even crop, portion of 100 acres, and was calculated to yield 32 bushels per acre. It was very free of weeds and disease (being the second crop), but contained a fair amount of admixture. The initial operation of fallowing was done with a combined cultivator drill in the previous July, and the fallow received two further workings with the same implement in August and November. The crop was planted at the end of April, 27 lbs. of graded seed and 57 lbs. of superphosphate being sown per acre.

The points awarded are shown in the following table:

Competitor.	District.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 points	10 points	10 points	15 points	15 points	100 points
Teale, R. ...	Turkey Hill	Nabawa ...	32	9	9	12	14	76
Worthing, F. J. ...	Southern Cross	Gluyas Early ...	29	8	8	13	14	72
Whann, T. J. ...	Moorine Rock	Nabawa ...	28	8	8	13	13	70
Cass-Smith, W. P. ...	Bullfinch ...	Gluyas Early ...	27	8	8	13	13	69
Davies, F. & J. ...	Corinthian ...	Nabawa ...	26	9	9	13	12	69
Brown, C. R. ...	Bullfinch ...	Gluyas Early ...	24	9	9	13	14	69
Copley, C. ...	do. ...	do. ...	26	7	9	13	13	68
Berry, T. ...	do. ...	do. ...	27	8	8	12	12	67
Davies, G. ...	Turkey Hill	Bald Early ...	24	9	9	12	13	67
Davies, F. & J. ...	Corinthian ...	Gluyas Early ...	22	8	8	14	13	65
Lecky, J. V. S. ...	do. ...	do. ...	23	8	8	13	12	64
Godfrey, F. H. ...	Bullfinch ...	do. ...	20	9	8	13	13	63
Copley, T. N. ...	do. ...	do. ...	21	7	8	13	13	62
Cooke, W. ...	do. ...	Baroota Wonder Early ...	21	6	9	13	12	61
Dowdell, A. E. ...	Moorine Rock	Nabawa ...	18	7	8	13	12	58
Duncan, A. P. ...	Bullfinch ...	Gluyas Early ...	18	6	8	12	11	56
McKay, D. ...	Corinthian ...	do. ...	13	8	8	13	13	55

Several competitors planted the variety Gluyas Early too early, with the result that the crops were affected by Septoria and frost. This and similarly maturing varieties should not be sown before the beginning of May.

Wild Turnip (*Brassica tournefortii*) was noticed in crops around Bullfinch and Turkey Hill. This is a very serious weed, and it is only by the co-operative effort of everyone concerned that it can be kept in check. It is advisable not to seed too early fallows over which the turnip plants are known to have been blown. By delaying seeding and by sowing an early variety as late as is safe in the correct seeding period, the farmer has an opportunity of killing by cultivation the young plants which germinate after the early seeding rains. Plants found growing in the crop should be removed by either hoeing or hand pulling before they flower. As the seeds of plants belonging to this botanical family are known to remain dormant in the soil for many years, farmers were warned that it is not a weed which they can expect to eradicate in one year.



The cultural details of the competitors are summarised in the following table:—

## CULTURAL DETAILS.

Competitor.	No. years cropped.	Timber.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Teale, R. ...	2nd	Salmon gum-let and jam scrub	July	Combined cultivator drill	in 3	Good	Cultivated with combined cultivator drill August and November, planted with same implement	Nabawa	End April ...	lb. 27	lb. 57	Copper carbonate	Yes	
Worthing, J.	3rd	Salmon gum-let and tea-tree	July	Disc ...	4	Good	Cultivated with combined cultivator drill Sept.; disc harrowed Oct.; drag harrowed and springtine cultivated March. Planted with disc drill	Glucas Early	2nd week May	25	95	Copper carbonate	Yes	Flag Smut.
Whann, T. J.	3rd	Gimlet ...	July	Disc ...	3	Good	Springtine cultivated end August. Planted with combined cultivator drill	Nabawa	End April ...	21	60	Copper carbonate.	Yes	Takeall
Cass-Smith, W. P.	3rd	Salmon gum-let and morrell	July	Disc ...	4	Good	Cultivated with combined cultivator drill Sept. and April. Harrowed Nov., planted with combined cultivator drill	Glucas Early	1st week May	27	60	Copper carbonate.	Yes	Flag Smut
Davies, F. & J.	1st	Salmon gum-let and mallee	July	Disc ...	4	Good	Cultivated with combined cultivator drill Sept.; planted with same implement	Nabawa	Mid-April ...	34	80	Copper carbonate	Yes	
Brown, C. R.	1st	Salmon gum-let, morrell and mallee	July	Disc ...	4	Good	Cultivated with combined cultivator drill Nov.; planted with same implement	Glucas Early	Last week April	30	45	Copper carbonate	Yes	
Copley, C. ...	4th	Salmon and gimlet	June	Disc ...	4	Good	Cultivated with combined cultivator drill Sept. Harrowed Nov. and cultivated March. Planted with combined cultivator drill	Glucas Early	1st week May	30	80	...	...	
Berry, T. ...	3rd	Salmon gum-let and tea-tree	June	Disc ...	4	Fair	Planted with combined cultivator drill	Glucas Early	1st week May...	25	65	Copper carbonate	Yes	Flag Smut

CULTURAL DETAILS.—continued.

Competitor.	No. years cropped.	Timber.	When ploughed	Implement	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed treatment.	Graded.	Disease.
Davies, G. ...	1st	Salmon gimlet, tea-tree and blackbutt	July	Springtyne cultivator.	3-4 in.	Good ...	Springtyne cultivated Sept., planted with combined cultivator drill	Bald Early	Mid-April ...	lb. 30	lb. 80	Copper carbonate	Yes	
Davies, F. & J.	4th	Salmon and gimlet	July	Disc ...	4	Good ...	Springtyne cultivated Sept. and Nov.; planted with combined cultivator drill	Glycas Early	Mid-May ...	34	80	Copper carbonate	Yes	Flag Smut
Lecky, J. V. S.	2nd	Salmon and gimlet	July	Disc ...	3-4	Good ...	Springtyne cultivated Oct. and Nov.; planted with a combined cultivator drill	Glycas Early	Mid-May ...	50	60	Copper carbonate	Yes	Flag Smut
Godfrey, F. H.	1st	Gimlet, mallee and scrub	June	Disc ...	3	Good ...	Cultivated with combined cultivator drill Sept.; harrowed Nov.; planted with combined cultivator drill	Glycas Early	3rd week April	27	50	Copper carbonate	Yes	Flag Smut
Copley, T. N.	2nd	Salmon, gimlet, mallee and morrel	July	Disc ...	4	Good ...	Cultivated with combined cultivator drill Sept.; planted with same implement	Glycas Early	3rd week April	27	80	...	...	Septoria
Cooke, W. ...	2nd	Salmon, gimlet, morrel and jam	July	Rigidtyne scarifier	3	Good ...	Springtyne cultivated October; planted with combined cultivator drill	Baroota Wonder Early	End April ...	25	70	Copper carbonate	...	
Dowdell, A. E.	3rd	Blackbutt, horse and mallee	June	Disc ...	4	Good ...	Reploughed and planted August; planted with combined cultivator drill	Nabawa	Mid-April ..	27	60	Copper carbonate	Yes	Takeall and Septoria
Duncan, A. P.	4th	Salmon, gimlet, morrel and mallee	June-July	Disc ...	3-4	Good ...	Cultivated with combined cultivator drill April; planted with same implement	Glycas Early	Mid-May ...	30	60	Copper carbonate	...	Flag Smut
McKay, D. ...	3rd	Salmon and gimlet	Aug.	Disc ...	4	Good ...	Planted with a combined cultivator drill	Glycas Early	Mid-April ...	34	75	Copper carbonate	Yes	Septoria

## BRUCE ROCK AGRICULTURAL SOCIETY.

Judge: G. L. THROSSELL, Dipl. Agric., Agricultural Adviser.

Six of the eight competitors in the 50-acre fallow competition submitted entries for the crop section of the fallow and crop competition conducted by the Bruce Rock Agricultural Society. The awards were as follow:—

## BRUCE ROCK AGRICULTURAL SOCIETY.

Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.

Competitor.	District.	Variety.	Yield. 50 points	Freedom from Weeds. 10 points	Freedom from Disease. 10 points	Freedom from Admix- ture. 15 points	Even- ness of Growth. 15 points	Crop total Points. 100 points	Fallow total Points. 100 points	Total Fallow and Crop. 200 points
Schilling, C. E. & N. S.	Bungul- luping	Merredin	34	9	8	14	14	79	92	171
Farrall, F. C., & Sons	Yarding	Glueclub	35	9	8	12	13	77	89	166
Leah & Son...	do.	do.	35	8	7	12	13	75	89	164
Buller & Black	Babakin	Free Gal- lipoli	30	8	8	14	12	72	91	163
Strange, P. A.	Yarding	Glueclub	31	8	8	12	12	71	90	161
Brown, S. A.	Bungul- luping	S.H.J. ...	24	7	7	13	12	63	89	152
Farrall, F. C., & Sons	Yarding	...	...	Stripped	...	...	...	...	90	...
Smith Bros....	Central Kunminlin	...	...	Withdrew	...	...	...	...	90	...

Messrs. C. E. and N. S. Schilling, of Bungulluping, won the combined competition with an aggregate of 171 points out of a total of 200 points. The crop submitted for inspection was of the variety Merredin, and excepting for the presence of a little Flag Smut this entry scored well in every section, being very free of weeds and admixture. The fallow on which this crop was sown won the fallow section of the competition and received the following working:—It was ploughed in June with a disc implement to a depth of 3-4 inches, received a further working with the same implement during the end of July and early August, and was cultivated with a combined cultivator-drill after rain in November and prior to seeding, which took place during the second and third week in May. Seed was sown at the rate of 60 lbs. and superphosphate 80 lbs. per acre respectively.

Competitors with the variety Glueclub lost points for admixture, it being very noticeable this year that this variety is showing considerable variation and the need for attention in this direction.

The rainfall for the various centres in the district was as follows:—

---	Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.		
Bruce Rock ...	...	...	216	192	64	342	254	194	107	26	987	...	1,444
Yarding ...	...	9	209	134	72	380	252	194	124	31	1,053	...	1,420
Central Kunminlin...	...	9	137	162	79	367	303	186	133	29	1,047	9	1,399
Babakin ...	...	3	214	154	57	341	330	149	126	23	1,026	...	1,467

The cultural details of the competitors are summarised in the following table:

CULTURAL DETAILS

Competitor.	No. of years cropped.	Timber.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Variety.	Planted.	Rate of seed.	Rate of super.	Seed Treatment.	Graded.	Disease.
Schilling, C. E., & N. S.	...	Salmon and gimlet	June	Disc	In. 3-4	Good	Reploughed with disc July-Aug.; cultivated with combined cultivator drill Nov.; springtine cultivated mid-May. Planted with combined cultivator drill	Morredin	2nd and 3rd weeks May	lb. 60	lb. 80	Copper carbonate	Yes	Flag Smut
Farrall, F. C., & Sons	9	Salmon, gimlet and morrel	June	Mould-board	4	Good	Portion springtine cultivated June, balance worked with disc Aug.; rigid type scarified Sept.; springtine cultivated Sept., Nov., and April. Planted with combined cultivator drill	Glueclub	Last week April	48	108	Copper carbonate	Yes	Flag Smut, Takeall
Leah and Son	8	Salmon, gimlet and morrel	June	Mould-board	3	Good	Cultivated with combined cultivator drill July, Aug., Oct.; rigid type scarified May. Planted with combined cultivator drill	Glueclub	Mid-May	50	90	Copper carbonate	Yes	Takeall, Flag Smut and Bunt
Buller & Black	...	Salmon, gimlet, jam & yorgum	June-July	Disc	3	Good	Harrowed July, rigid type scarified Aug., Oct. Mch. and prior to seeding. Planted with disc drill	Free Gallipoli	1st week May...	52	120	Copper carbonate	Yes	Takeall and Plug Smut
Strange, P. A.	7	Jam, yorgum and wattle	July-Aug.	Mould-board	3-4	Good	Springtine cultivated Sept., Mar. and April; planted with combined cultivator drill	Glueclub	1st week May...	55	103	Copper carbonate	Yes	Flag Smut and Septoria
Brown, S. A.	5	Salmon, gimlet and mallee	July	Rigid type scarifier	3	Good	Cultivated with disc in Sept.; rigid type scarified Nov. and prior to seeding planted with combined cultivator drill	S.H.J	Mid-May	50	94	Copper carbonate	Yes	Takeall

## THE APPLE CURCULIO.

(H. G. ANDREWARTHA, B.Sc. in Agric., Entomology Branch.)

This weevil (*Otiorrhynchus cribricollis*) was described by Gyllenhal from specimens collected in Southern France as far back as 1834. It is a native of the Mediterranean regions of France and Italy, where it feeds upon various species of *Medicago*, including Lucerne (*Medicago sativa*). It has been recorded feeding upon Olives and other cultivated plants in Algeria. Two years ago the first record of its appearance in California was made, where it apparently feeds upon ornamental trees and shrubs. In 1906 the Curculio was first mentioned in Australian literature by Quinn in the Journal of Agriculture for South Australia. Since then it has been recorded as damaging almost every variety of fruit tree that is grown there. The exact date of its importation into this State cannot be ascertained, but there is no doubt that it has been in the Bridgetown district for 30 years, and probably much longer. This weevil has been spreading in recent years, until now there are records of its having appeared in the following widely separated districts—Bridgetown, Balingup, Donnybrook, Karragullen, Mount Barker, Katanning, Narrogin and Kalgoorlie.

### DESCRIPTION AND LIFE HISTORY.

When first laid the eggs are a pearly white, but within a few days they become a lustrous sooty black. They are oval in shape, and are 1/32-inch long by 1/40-inch wide. They are probably laid promiscuously on or under the surface of the soil throughout the orchard. Egg-laying commences about the middle of March, reaches its maximum about three to five weeks later, and then dwindles until the last few are laid late in May or early in June. Each weevil lays about 55 eggs. About three weeks after the rain sets in the first of these hatch; the last larvae to emerge from the eggs do so some time late in July.

The newly emerged larva is a minute legless grub about 1/20-inch long. It is white except for the head, which is a brownish yellow. The widest part of the larva occurs just behind the head, from which point it tapers posteriorly. The first consideration of this tiny grub is to burrow into the soil, where it searches out a root of one of the many weeds which are germinating in the orchard at this time. The larvae feed throughout the winter, but only grow slowly until about August. From August on to early November growth is very rapid. The mature larva is about half an inch long, shaped and coloured much the same as the newly hatched grub. When dug up from the ground they curve themselves in the shape of a crescent. They occur throughout the orchard between about 3 inches and 15 inches below the surface.

The pupa is white, slightly less than half an inch long, and provided with the developing legs, antennae and wing cases of the adult which are all plastered down outside the body. It is invariably found in a small earthen cell, which is excavated by the larva before pupating. The first larvae begin to pupate about the third week in October, but the majority of them do not pupate until about the first week in November. The pupae all occur between 9 inches and 12 inches below the surface. The pupal stage lasts for about three weeks.

Late in November and early in December the adults emerge and commence feeding. They are a typical weevil, with their head produced forward into a snout and their antennae elbowed. They are slightly more than 1/4-inch long, and of a

uniform reddish brown or brownish black colour. The head and thorax are uniformly pitted, as are the elytra or wing covers which, in addition, are provided with a dusting of very fine whitish scales and a number of fine whitish hairs. They have no wings, and hence cannot fly. Their tarsi are provided both with claws and pads to assist them in climbing.

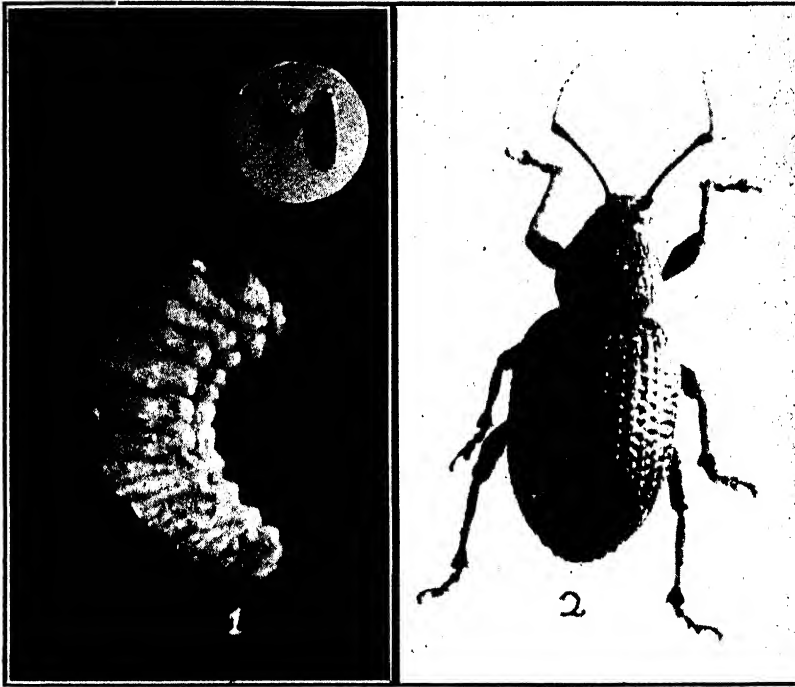


Plate I.

(1) Fully grown larva  $\times 6$ .

(2) Adult weevil  $\times 6$ .

Inset: Newly hatched larva and the egg from which it has emerged  $\times 6$ .

They feed without laying any eggs for about six weeks after their emergence. Early in January they become inactive, and cease feeding. About 20th February they commence feeding again, and continue late into the autumn, when most of them die. The first eggs are laid about the middle of March, and the last early in June.

The above is a brief description of the complete life cycle from egg to adult and death of this curculio, but some individuals vary this routine. Variations occur both in the larval and adult stages. Some larvae are much slower than normal in their development, with the result that they are less than half-grown when the summer sets in. These burrow down two or three feet and aestivate. Throughout the long summer they remain in earthen cells in the damp subsoil, neither feeding nor growing. When the winter rains set in they recommence feeding, gradually working their way towards the surface to pupate and emerge amongst the earliest of the December swarm. So far as can be gathered, about 12 per cent. of the total larvae aestivate each year.

Although most of the adults die in the autumn after having lived for about five months, about 14 per cent. live on right through the winter, feeding very little until about the end of September, when they start feeding regularly and lay about two eggs each. They cease feeding again about mid-November, start again about mid-December, and feed until about 15th January, when they join the new season's brood in their mid-summer spell. These weevils feed again about 20th February, lay the remainder of their eggs, and die later in the autumn.



Plate II.

Apple leaves showing typical curculio damage. Note the serrating of the edges and the holes.

#### NATURE AND EXTENT OF THE INJURY.

The only time in which the weevil does any damage is in the adult stage. The larvae feed upon the finer roots of the weeds in the orchard and only occasionally eat the apple roots, but the adults when numerous, as they often are, do very serious damage. When they first start feeding in December, they confine their attentions to the edges of the leaves, though they sometimes eat holes in them. For about a fortnight before they become inactive, however, they have a tendency to nibble the stems of the apples and the leaves, and often cut these right off. It is quite a common sight at this time of the year to see an orchard which is badly in-

festes with curculio thick with fallen leaves. When they start feeding again in the autumn, they eat the leaves, but in addition, there is a big tendency to ring-bark the buds and spurs, and also the stems of the apples. This is when the most serious damage is done, as the weevil invariably attacks the weak and sickly limbs



Plate III.

A Jonathan showing severe weevil injury. Note how the weak side has been attacked.

and can often, as the result of their bark-eating habits, kill these right out, or at least prevent them from growing. In this way a tree which happens to be weak in one side becomes even more so.

#### GENERAL HABITS OF THE ADULTS.

These weevils are night feeders. During the day they lie concealed beneath the soil about three inches below the surface. With the approach of night they emerge from their shelter, climb up the trees and feed until the morning, when they climb down and again seek shelter. Calm dewy nights are most favoured for feeding. Not all the weevils are feeding every night. They do not all climb the tree nearest to them, but many wander off to other trees. This wandering tendency is accentuated if a tree is rendered difficult to climb by having a band placed around its trunk. The majority of the weevils do not go far from the tree when they climb down in the morning, but bury themselves within a few inches of the butt. The soil around a typical tree was examined to a depth of nine inches in nine-inch strips away from the trunk, with the results shown in the following table:—

		No.	Per cent. of total.
First—nine inches	.. ..	396	61.7
Second—nine inches	.. ..	180	28.0
Third—nine inches	.. ..	64	9.9
Fourth—nine inches	.. ..	3	0.4



## CONTROL MEASURES.

During the investigation of this pest the author has seen many different methods of control, but most of them have serious drawbacks. Many do not give a complete enough control while others although effective, are costly in labour or materials. Methods of control can best be discussed under seven headings:

1.--*Cultural Methods.*

The only two ways in which methods of cultivation can be used to fight soil inhabiting insects are unfortunately impracticable with *Otiorrhynchus cribricollis*. It is not possible to starve the larvae out by maintaining a clean fallow in the orchard, as the weeds throughout the winter are essential, and even if it were possible to keep them down for one winter, the larvae would very probably feed



Plate IV.

Apple twigs showing the ringbarking which is typical of the damage done during the autumn feeding period.

upon the apple roots. The other method sometimes employed against soil insects is to cultivate during the pupal stage. With the apple curculio, pupation does not occur until early in November, and by this time the orchard has already been ploughed twice and probably cultivated. The ploughing disturbs the larvae and turns many thousands of them up, but unfortunately it kills very few; they merely

burrow down again below the level of the ploughing, so that subsequent ploughing and cultivating does not reach them either while they are still larvae or after they have pupated. Were it possible to postpone the first ploughing until early in November the majority of the larvae would have pupated between six inches and nine inches below the surface, and most of them would be destroyed by the plough, but as it is not possible to postpone the first ploughing to this date, cultural methods offer no means of controlling this pest.

### 2.—*Biological control.*

Although this weevil is not regarded as a serious pest in its native home, as far as our investigations have gone, this seems to be the result of climatic and other conditions rather than due to the presence of parasites.

### 3.—*Banding methods.*

The object of this method is to prevent the weevils from climbing the trees, and thus to starve them out. Many different types of band have been suggested. In order to test them out under equal conditions, an experiment was conducted at Mr. Hester's property, Bella Vista, Bridgetown. A block of trees, six trees square, was divided up into four blocks of nine trees each. The central tree in each block was left untreated for a control, and the trees around it were banded alternately with full woolled merino sheepskin bands, metal bands, and Ostico bands. The wool was washed in warm, soapy water, cut into strips about one inch in diameter and tacked around the trunks of the trees with the wool innermost, in such a way as to leave about two inches of wool protruding beyond the edge of the skin. The metal bands were made of galvanised flat iron, as described by Flintoff in this Journal for June, 1929, page 333. The trees on which these were placed were first banded with a narrow piece of sacking; the band was then put in position and pulled up as tight as it would go, any cracks due to the irregularities in the trunks being packed with wool.

Ostico is a sticky tree-banding material which is sold by the Westralian Farmers, Ltd., and was used in these experiments as being typical of a number of similar tree-banding preparations on the market. It was smeared on grease-proof paper, which was then tied to the trunk with string.

Above all the bands was placed a fairly wide band of sacking, whose purpose was to induce those weevils which did succeed in crossing the band to camp there on their way down in the mornings. The four control trees had similar sacking traps, but no preventive bands.

The experiment was initiated on 23-10-30. When it was examined on 14-11-30 it was found that some of the over-wintering weevils had succeeded in crossing the bands on some trees, as shown in the following table:—

No. of tree.	Treatment	No. weevils.
4	wool band	6
8	control	3
11	control	6
17	wool	1
20	wool	1
25	wool	3
26	control	8
27	wool	1
28	Ostico	1
29	control	8
30	wool	4

The trees which do not figure in the table had no weevils above the bands.

When the experiment was next examined on 2-12-30 the new season's weevils had crossed every type of band in hundreds, and were doing a very considerable amount of damage to all the trees. It is thus very evident that the three types of band used in this experiment were failures. Doubtless, they offered some resistance to the weevils, but certainly not enough to make them worthy of consideration.

These bands were all put on about two months before cultivation ceased in the orchard, and although this could not have affected either the wool or metal bands, it was thought that possibly the failure of the Ostico was due to its becoming coated with dust from the cultivating. Consequently, some further experiments were planned with it. Eight trees were treated in Mr. Martin's orchard at Queenwood on 5-12-30. The Ostico was placed on grease-proof paper and on metal bands. In the former case a piece of cotton wool was tied around the trunk. The Ostico was spread on grease-proof paper, which was then tied over the cotton-wool. The metal bands were put on as described above, and the Ostico painted on to the band. The details of the treatments and the number of weevils getting over nightly are shown in the following table:—

No. of Trees.	Treatment.	No. of Weevils getting over in specified nights after treatment.										Total.
		1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	
1	Ostico on metal	5	5	...	4	1	...	5	2	3	...	25
2	" " paper	...	14	7	3	3	...	2	8	2	8	54
3	" " paper	...	5	1	10	...	1	12	...	8	1	38
4	" " paper	71	...	4	0	...	24	0	...	...	12	111
5	" " paper	...	...	0	1	...	...	...	...	...	...	3
6	" " metal	5	3	2	1	...	2	2	1	...	...	16
7	" " paper	21	10	2	10	4	2	15	2	32	1	99
8	" " metal	14	34	14	11	10	14	13	5	113	18	246

Four control trees alongside averaged about fifty weevils per night, or a total of 500. It is thus evident that the bands stopped or drove away about 85 per cent. of the weevils present. This is a fairly good result, but nevertheless, this method has one very serious drawback. There are pieces of grass straw constantly blowing about the orchard, and it only needs one of these to land on the band for it to form a bridge, over which the weevils pass very readily. This, combined with the dust, tend to prevent the Ostico from remaining a very efficient barrier for more than a couple of weeks at a time, and hence this method cannot be recommended as an economic means of control of the curculio.

#### 4.—Soil fumigation methods.

These methods depend upon the habit which the weevil has of burying itself close to the butt of the tree during the daytime. Some soil fumigant, such as Cyanogas (Calcium cyanide), is placed under the soil around the trunk of the tree in the day time, or alternatively on the surface of the soil as the weevils are about to ascend the tree. Either method would probably be moderately successful if all the weevils ascended the tree to feed every night, but unfortunately some are wandering over the orchard and others lying quietly beneath the soil on every night. Consequently, before these methods can be successful they must be repeated several times, so often in fact, as to render them uneconomical.

### 5.—*Trapping methods.*

The following is a description of the methods used very successfully by Mr. Keall, of Queenwood, in controlling this pest. He places a sacking trap bandage about nine inches wide around the butt of the trees. The weevils congregate under this, and he goes around daily, or every few days, destroying them either by allowing fowls which are running in the orchard to eat them, or by collecting and killing them in a tin containing oil. Practised assiduously over two years, this method has proved very effective, as the numbers on his orchard have been reduced from many thousands per tree to less than one hundred per tree. However, even though this method has been successful in controlling the weevils, it has proved very expensive in labour, and for that reason can hardly be recommended as an economic means of control.

### 6.—*Poultry.*

It has been demonstrated in a number of orchards that fowls are particularly fond of the apple curculio. Consequently it is possible by systematically running them in the orchard to obtain a very good control of the weevil. If this method is to be used, arrangements should be made to place about 100 half-grown White Leghorn fowls in every acre of infested orchard each year about the beginning of December. To make a success of this method it is necessary to build catproof coops for the birds in the orchard, and to water and feed them there. The fowls can either be reared on the premises, as does Mr. Johnston of "The Cascades," Greenbushes, or they may be purchased annually. About this time the poultry farmers always have numerous culled cockerels about eight weeks old for sale at very cheap rates.

There is much diversity of opinion among growers as to whether or not this method is practicable and worth the trouble, labour and expense involved, but there is little doubt that if it is properly and systematically carried out, it gives very good control of the weevil.

### 7.—*Poisoning.*

This is probably the most practicable method of all. The poison can be applied either as a spray or as a bait. The important point to watch is the time of application. If one refers back to the description of the life history given above, it becomes apparent that the vulnerable period in the life of this pest is during its December feeding. During the six weeks between 25th November and 5th January every weevil of both the over-wintering and new season broods are feeding, but they do not reach sexual maturity, *i.e.*, no eggs are laid, until after their mid-summer period of inactivity. Hence it is obvious that any campaign against them should be launched at this time in order to kill them before they can lay their eggs.

For this end, spraying with arsenate of lead at the rate of 1 lb. of paste to 8 gallons of water is recommended for young trees, or trees not bearing fruit. The time of application should be the first week in December. If the trees are growing rapidly, it may be necessary to repeat the spray about 10 days later. Unfortunately this method cannot be employed where the trees are bearing a crop as the strength used is well outside the limit of safety laid down by the regulations of the Department of Public Health.

For trees bearing fruit a bait has been evolved during the progress of this investigation which, although not thoroughly tested yet, has given very excellent results so far. This bait is made by mixing 9 lbs. of ground dried apple with 1 lb. of powdered sodium fluoride or arsenate of lead. The former has a quicker poison-

ing effect upon the weevil, but is must less dangerous to humans than the latter. It should be applied about the first week in December, or the last week in November. A narrow strip of the bait should be placed around and close to the butt of each tree. It is necessary to watch that a complete ring of bait is used so that no weevils can ascend the tree without first coming in contact with the bait. They are so keen on the dried apple that very few will climb the tree in preference to eating the bait on the ground. The advantage of the apple is that it is hygroscopic, *i.e.*, it takes up moisture from the air and remains moist and palatable for weeks after it is applied. For this reason it is not necessary to repeat the application unless heavy rains occur after it has been laid. It is estimated that 10 lbs. of bait will do from  $\frac{3}{4}$ -1 acre of orchard. As it will require 5 lbs. of green apples to make 1 lb. of the dried material, it will be necessary to dry 50 lbs. of fresh apples for each acre of orchard to be baited.

In order to make the drying a "spare time" job, it will be necessary either to dry the "rejects" after the rush of picking and packing is over, or else to dry the windfalls before the such period begins. Once dried, the apples should be minced or ground up and mixed at the rate of 9 lbs. to every 1 lb. of sodium fluoride. Care should be taken to incorporate the poison evenly throughout the apple. Once mixed, the bait may be stored in tins or other suitable containers until it is required in the first week in December.

The price of sodium fluoride in Perth is 2s. 2d. per lb. As 1 lb. of poison is sufficient for one acre of orchard, the price for three is slightly under  $\frac{1}{4}$ d. The windfall or reject apples cost nothing. If the drying and mixing of the bait is made a spare-time job, the cost of the labour in making the bait would be very small. Further, the labour involved in applying it is very much less than in any of the other methods of control. Hence, this method scores both in the cheapness of the materials and low cost of application.

### SUMMARY.

*Otiorrhynchus cribricollis* was introduced into Western Australia more than 30 years ago, since when it has spread alarmingly.

The normal life cycle occupies one year, but some individuals vary from normal; some larvae aestivate through the summer and some adults hibernate through the winter.

The adults feed in two periods, the first in the early summer and the second in the autumn.

The nature of the damage varies a little with the period of the year.

The eggs are laid in the autumn, between 15th March and early June.

In controlling the pest it is essential to attack it before sexual maturity is reached, *i.e.*, during the first period of feeding—November, December.

Control measures recommended are:—

(a) For young trees or trees not bearing fruit, spraying with arsenate of lead at the rate of 1 lb. of paste to 8 gallons of water (or 1 lb. of powder to 16 gallons) applied the first week in December and repeated ten days later if necessary, owing to rapid growth of the trees.

(b) Baiting with the following mixture:—ground dried apple 9 lbs., sodium fluoride 1 lb., for all trees whether bearing fruit or not.

(c) Running poultry in the orchard.

## SEED TESTING FOR FARMERS, SEED MERCHANTS, ETC.

Farmers and others interested are advised that seed samples will be tested for purity and germination by the officers of the Plant Pathology Branch of the Department of Agriculture, at the following statutory charges (Agricultural Seeds-Act, 1923) :—

	s.	d.
Purity only .. .. .	5	0
Germination only .. .. .	2	6
Complete test (purity and germination) ..	6	0

### SIZE OF SAMPLES AND METHOD OF SAMPLING.

Samples submitted for testing must be taken in such a way as to represent as accurately as possible the whole bulk. Thus equal amounts should be taken from each container, and from the same respective places in containers.

The following are the minimum samples necessary for obtaining the "bulk sample":

*1-5 bags.*—Take equal samples from top, middle, and bottom of each bag.

*6-50 bags.*—Sample every fifth bag, with a minimum of five.

*50 bags upwards.*—Sample every tenth bag, with a minimum of ten.

*Bins, cars, etc.*—Sample by a long trier, or probe, in several places in each container.

*Packet Seeds.*—Select entire packets for test.

The total quantity of seed obtained, as above, will be in excess of that required to be sent to the Department of Agriculture for testing, so it should be thoroughly mixed prior to division, and a representative portion of the "bulk sample" sent for examination.

The following are the *minimum* weights of samples which should be submitted for testing:—

- Wheat, oats, barley, rye, maize, peas, beans, cowpeas, soybeans, or seeds of size similar to any of these—1 lb.
- Vetches, tares, rice, sorghums, sudan grass, linseed, rape, buckwheat, cotton, subterranean clover, or seeds of size similar to any of these—8 ounces.
- Lucerne, canary grass, prairie grass, millet, rye grasses, clovers not enumerated elsewhere, birdsfoot-trefoils, melilots, medics, trefoils, or seeds similar in size to any of these—4 ounces.
- Grasses other than those already mentioned, and all other seeds not already allowed for—2 ounces.

### INFORMATION PROVIDED BY THE SEED CERTIFICATE.

The Seed Certificate, issued for each sample of seed submitted for testing, provides, among other things, the following information:—

- The percentage by weight of "*pure seeds*" (*i.e.*, the outwardly-sound seeds (only) of the kind submitted for testing).
- The percentage by weight of *weed seeds*.
- The percentage by weight of *other crop seeds*.

- (d) The percentage by weight of *inert matter* (rubbish, sticks, broken seeds, stones, etc.).
- (e) The *percentage germination*, by number, of the "pure seeds."
- (f) The percentage, by number, of "*hard seeds*" (if any).
- (g) The percentage by number of *dead seeds*.
- (h) The percentage, by number, of *seeds which germinate but do not give a seedling capable of establishing itself*.
- (i) The percentage, by number, and identity of *noxious weed seeds* (if any) in the sample, and also the number calculated to one pound of sample.
- (j) The percentage, by number, and identity of *other weed seeds* in the sample, and also the number calculated to one pound of sample.
- (k) The percentage, by number, and identity of *other crop seeds* in the sample, and also the number calculated to one pound of sample.
- (l) The nature of the *inert matter* present (sticks, stones, broken seeds, empty husks, etc.).
- (m) The "*Actual Value*" or "*Purity Value*" percentage of the sample (*i.e.*, the percentage by weight of the sample which consists of pure germinable seeds).
- (n) Any other remarks which may be considered of interest.

Samples for testing, accompanied by the Statutory Fee, as indicated above, should be addressed to the—

Plant Pathologist,  
Department of Agriculture,  
St. George's Terrace,  
Perth.

## FIELD EXPERIMENTS WITH WHEAT AND OATS, 1930.

### MERREDIN EXPERIMENT FARM.

I. THOMAS, Superintendent of Wheat Farms.

and

J. H. LANGFIELD, Farm Manager.

The total rainfall for the year ending 31/12/30 was 13.33 inches, and during the growing period 8.23 inches. The following table shows the monthly rainfall together with the average over a period of 19 years:—

Year.	Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.			
1930 . . . . .	...	1	281	188	40	363	187	184	65	34	823	1	1,333
Average, 19 years ...	55	56	125	79	130	195	188	140	93	75	821	44	1,234

The season opened with splendid rains during March and April, 4.67 inches being recorded; this was responsible for giving the weeds a good start before seeding commenced. May was a dry month, and lent itself admirably for killing the weeds; it was also responsible for allowing the seeding to proceed uninterrupted. Owing to the growth of weeds on the fallow it was necessary to cultivate several times in order to kill them. This was responsible for the loss of moisture in the surface soil, and delayed the germination of the May plantings until after rain, which fell on June 1st.

The season progressed very satisfactorily until September, when the rainfall was again very light, only 65 points being registered in that month in eight falls, the heaviest of which was 16 points. October was also dry (34 points only being recorded).

The land on which the experiments were planted originally carried a forest of salmon gum and gimlet, and the soil is typical of that class of country. The farm is worked on a three year rotation, namely fallow, crops (mainly wheat and oats) and pasture.

The experimental block received uniform treatment, being ploughed with a heavy disc plough to a depth of 4in. in June, 1929, reploughed in August and springtyne cultivated in March, after rain. Excepting where otherwise stated, or where the requirements of an experiment necessitated a modification of the treatment, the fallow was given a further cultivation with a springtyne cultivator prior to seeding.

#### TIME OF SEEDING EXPERIMENT.

This experiment has been conducted for the past eight years with Gluyas Early planted mid-May, June and July, and for two years with the mid-season variety Nabawa, planted mid-April, May and June.

In addition to the general cultural operations outlined the May, June and July plots were cultivated prior to seeding the May plots: the June and July again in June and the July plots again before seeding.

The plots sown in April made a good even germination, but owing to very dry conditions during May made very slow growth. The May sown plots did not germinate until after rain fell on June 1st, making them two weeks late.

The results obtained this year, together with the average results of past years, are as under:—

#### TIME OF SEEDING EXPERIMENT.

Variety—Nabawa.

Superphosphate—150lb. per acre.

Seed—45lb. per acre.

Planted.	Computed Yield per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929-30.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
April 17     ...     ...	bus. lb. 34 16	bus. lb. 33 28	bus. lb. 34 8	bus. lb. 33 52	bus. lb. 34 24	bus. lb. 34 2	% 120	bus. lb. 28 15	% 112
May 15     ...     ...	28 48	28 40	27 52	26 24	29 36	28 16	100	25 19	100
June 16     ...     ...	14 48	16 40	12 32	16 0	20 0	16 0	57	14 59	59



Variety—Gluyas Early.		Superphosphate—150lb. per acre.					Seed—45lb. per acre.			
Planted.		Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1923-30.	Per-centage Yields, 1923-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
June 16th	...	26 16	28 48	29 52	27 20	28 48	28 13	83	21 34	83
May 17th	...	34 0	34 8	33 36	35 12	34 0	34 11	100	26 2	100
July 14th	...	14 0	14 0	11 12	15 4	13 4	13 28	39	12 20	48

The results obtained with both varieties confirm those of previous years, the conclusion being that it is inadvisable to extend the planting period to the month of June. If it is not possible to complete the seeding during the month of May, it is better to plant a suitable mid-season variety in April.

#### RATE OF SEEDING EXPERIMENT.

As in previous years this experiment was carried out with two varieties, viz., Nabawa, representing the free stooling varieties, and Noongaar, representing the sparse stooling varieties.

In addition to the general working outlined, the land was given a springtynne cultivation prior to seeding the Nabawa, and then harrowed. The Noongaar plots were disc cultivated before seeding.

Germination was patchy, some of the patches not showing up until after rain on June 1st.

The results are as under:—

#### RATE OF SEEDING EXPERIMENT.

Planted on 26th April, 1930. Variety—Nabawa. Superphosphate—150lb. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1913-30.	Per-centage Yields, 1913-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
30lb. ... ..	34 40	33 36	33 12	30 8	31 12	32 34	95	19 24	95
45lb. ... ..	35 36	33 52	34 24	32 48	33 52	34 6	100	20 28	100
60lb. ... ..	34 24	34 16	34 24	33 52	33 4	34 0	100	20 33	100

Planted on 27th May, 1930. Variety—Noongaar. Superphosphate—150lb. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1923-30.	Per-centage Yields, 1923-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
30lb. ... ..	32 56	28 16	25 44	25 44	24 16	27 23	98	18 10	97
45lb. ... ..	32 56	27 44	27 36	25 4	26 24	27 57	100	18 40	100
60lb. ... ..	32 0	28 32	27 4	25 12	26 56	27 57	100	18 18	98

The results obtained at this farm show that it is unnecessary to sow either the sparse or the free stooling varieties at a rate higher than 45 lbs. per acre.

## TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to determine whether, when heavy dressings of superphosphate are applied, it would be profitable to apply part or whole of the amount when cultivating the fallowed land during late summer or early autumn.

Before seeding the land was disced and cross-disced with a tandem disc and harrowed after seeding. Owing to the absence of rain the seed did not germinate until after rain on 1st June.

The layout of the experiment and the results obtained are given below:—

## TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 12th May, 1930.

Variety:—Ghuyas Early.

Seed—45lb. per acre.

Time of Application of Superphosphate.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1928-30.	Per-centage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
75lb. super. in March; 150lb. at Seeding ...	28 56	25 36	27 28	31 20	28 16	28 19	103	24 25	106
225lb. in March ...	29 4	26 32	26 40	28 24	27 20	27 36	100	23 2	100
150lb. in March + 75lb. at Seeding ...	28 40	29 52	32 48	31 20	32 0	30 56	112	24 50	108

The results this year confirm, but to a lesser extent, those of the previous year, indicating, as they do, that the yields of the wheat crop are decreased when portion of the fertiliser is not applied at seeding time.

## RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

In 1929 it was decided to enlarge this experiment so as to ascertain in what proportion a greater rate of superphosphate, up to 300 lbs., would affect the yield, although it was not anticipated that it would be profitable to apply that quantity. It was also decided to include a zero plot having no superphosphate.

In order to preserve the three-plot system this experiment was divided into two sections, in each of which plots treated with 150 lbs. of superphosphate per acre were regarded as controls. Thus in section 1, the rates of 300 lbs. and 225 lbs. per acre were compared with the control rate of 150 lbs. per acre, and in section 2 the rates of no superphosphate and 75 lbs. were compared with the control rate.

From the yields on the plots where no superphosphate was applied, it is evident that the crop is benefiting from the residual effects of previous dressings, but as this plot falls on the same place each year, any residue in the soil should eventually become exhausted.

The land was disced and cross-disced with tandem disc prior to seeding and harrowed after. Germination did not take place until after rain on June 1st.

The results obtained are shown hereunder:—

## RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT, No. 1.

Planted 12th May, 1930.

Variety:—Ghuyas Early.

Seed—45lb. per acre.

Treatment.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1929-30.	Per-centage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
300lb. super. per acre	30 8	31 52	31 44	32 8	27 44	30 43	113	28 8	107
150lb. super. per acre	30 24	29 4	27 20	24 32	24 40	27 12	100	26 15	100
225lb. super. per acre	30 24	31 26	31 4	27 44	27 28	29 39	109	27 32	105

## RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT, NO. 2.

Planted 12th May, 1930.

Variety—Gluyas Early.

Seed—45lb. per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929-30.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
No Super. ... ..	bus. lb. 13 4	bus. lb. 12 40	bus. lb. 13 20	bus. lb. 10 24	bus. lb. 15 12	bus. lb. 12 56	% 46	bus. lb. 16 29	% 60
150lb. ... ..	23 44	27 36	28 0	30 24	30 56	28 8	100	27 41	100
75lb. ... ..	24 56	22 48	25 44	26 32	26 8	25 14	90	25 10	91

These results indicate that for this class of country, and with wheat at its present price, it is profitable to apply superphosphate up to about 112 lbs. per acre.

## SEASONAL PLANTING EXPERIMENT.

The objects of this experiment are:—

1. To ascertain the most suitable month to plant the Late, Midseason and Early maturing varieties of wheat.
2. To determine the most prolific of each of the three types.

To meet the requirements of this experiment, three sections were needed, viz.:—

- (a) Section 1, planted in April, representing Early planting.
- (b) Section 2, planted in May, representing Midseason planting.
- (c) Section 3, planted in June, representing Late planting.

The arrangement of the experiment was similar to that of last year, the control plots, of the variety Nabawa, all being planted in the respective months of the three sections. In addition to the cultivations already outlined, the land was spring-tyne cultivated prior to seeding and harrowed after.

The tabulated results are shown hereunder:—

## SEASONAL PLANTING EXPERIMENT.

## April Planting.

Planted on 16th April.

Seed—45lb. per acre.

Superphosphate—150lb. per acre.

Variety.	Maturity.	Date Planted.	Computed Yield per Acre.					Average Yield per acre, 1930.	Average percentage Yield per acre, 1930.	Average percentage Yield per acre, 1928-30*
			Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
Yandilla King	Late ...	17-4-30	bus. lb. 28 56	bus. lb. 27 12	bus. lb. 23 12	bus. lb. 29 12	bus. lb. 27 36	bus. lb. 27 14	% 92	% 76
Nabawa ...	Midseason	"	31 20	30 40	30 0	28 56	27 4	29 36	100	100
Bencubbin ...	do. ...	"	33 36	32 16	28 56	34 8	31 52	32 10	109	110*
M.14 (Nabawa x Bunyip)	Very early	"	19 12	17 36	17 4	21 12	21 4	19 14	68	...
Nabawa ...	Midseason	"	28 8	27 4	28 16	29 20	27 44	28 6	100	100
Gluyas Early ...	Early ...	23-4-30	24 40	25 44	27 4	27 4	25 52	26 5	87	86
Carrabin ...	Early ...	"	22 56	25 44	28 40	32 0	32 24	28 21	94	90
Nabawa ...	Midseason	"	27 4	28 0	30 0	33 36	31 52	30 6	100	100
M.20 (Nabawa x Gluyas Early)	Early ...	"	26 16	27 20	29 20	31 36	32 8	29 20	97	...

\* Average 2 years, 1929-30.

*May Planting.*

Planted 16th May.

Seed—45lb. per acre.

Superphosphat e—150lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields per acre, 1930.	Per-centage Yields per acre, 1928-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Yandilla King ...	Late ...	24 24	24 32	21 20	20 0	19 36	21 58	74	71
Nabawa ...	Midseason ...	32 0	32 16	30 8	28 8	25 28	29 36	100	100
Beneubbin ...	Midseason ...	36 8	35 4	34 10	32 8	27 36	33 7	112	112
M. 14 (Nabawa x Bunyip) ...	Early ...	29 4	29 52	28 8	26 56	25 12	27 50	100	*
Nabawa ...	Midseason ...	29 44	31 4	28 32	26 0	24 24	27 57	100	100
Carrabin ...	Early ...	31 12	31 44	30 16	31 12	24 24	29 46	106	101
Merredin ...	Early ...	30 0	31 36	30 32	30 48	27 12	30 2	107	108
Nabawa ...	Midseason ...	29 36	29 44	26 56	26 24	28 16	28 11	100	100
Gluyas Early ...	Early ...	28 24	30 16	28 16	28 24	25 20	28 8	100	107
M. 20 (Nabawa x Gluyas Early) ...	Early ...	30 16	31 20	28 48	30 8	24 32	29 1	107	*
Nabawa ...	Midseason ...	29 52	29 20	26 40	28 0	22 8	27 12	100	100
S.H.J. ...	Early ...	26 16	25 4	26 8	25 20	19 28	24 27	90	93
Geeralyng ...	Very Early ...	25 4	24 56	25 28	25 4	19 28	24 0	87	95
Nabawa ...	Midseason ...	31 36	29 28	24 56	29 44	22 32	27 39	100	100
Noongaar ...	Very Early ...	33 52	32 16	30 56	32 8	26 24	31 7	113	111

\* Planted 1930 only.

*June Planting.*

Planted 17th June.

Seed—45lb. per acre.

Superphosphate—150lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields per acre, 1930.	Per-centage Yields per acre, 1928-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Beneubbin ...	Midseason ...	27 36	27 4	29 12	26 8	26 16	27 15	122	*
Nabawa ...	Midseason ...	20 40	21 28	24 56	22 24	21 52	22 16	100	100
Gluyas Early ...	Early ...	24 16	24 48	27 36	26 32	25 52	25 49	116	116
M. 14 (Nabawa x Bunyip) ...	Early ...	23 4	22 40	27 20	24 0	23 4	24 2	108	*
Nabawa ...	Midseason ...	18 56	21 28	23 20	23 28	23 52	22 13	100	100
Merredin ...	Early ...	25 4	25 4	27 44	27 52	28 40	26 53	121	110
S.H.J. ...	Early ...	22 40	23 52	27 52	26 24	25 28	25 15	110	92
Nabawa ...	Midseason ...	21 4	23 20	24 48	23 28	22 32	23 2	100	100
Carrabin ...	Early ...	23 4	24 56	25 28	23 44	24 56	24 26	106	101
Geeralyng ...	Very Early ...	22 48	23 36	23 28	22 48	24 8	23 22	102	97
Nabawa ...	Midseason ...	20 48	24 0	23 44	22 32	24 0	23 1	100	100
Noongaar ...	Very Early ...	27 44	30 0	30 0	28 40	30 24	29 22	128	117

\* Planted 1930 only.

From the average results for the past three years it will be seen that Yandilla King, the standard late maturing variety, is too late for this district and even for early planting does not give as good returns as Nabawa. The new variety, Beneubbin, has done well again in all sections. The early and very early varieties are obviously unsuitable for early planting, but they show to advantage in the May and June seeding.

In the May planting the varieties Merredin, Gluyas Early and Noongaar have given the best returns over the three years. They are, however, liable to Flag Smut, and for that reason it is interesting to observe that the new midseason variety, Beneubbin, which is resistant to this disease, has given promising returns.

The new crossbred M. 20 (Nabawa x Gluyas Early) produced at this farm, is also Flag Smut resistant, and, maturing as it does about the same time as "Gluyas Early," shows promise of becoming the Standard Early Maturing Variety.

In the June planted section the results of Beneubbin and M. 14 (Nabawa x Bunyip) are for one year only, so that no definite conclusions can be arrived at. The average results for this year, however, show that, should it be found necessary

to extend the planting period into June, higher yields will be obtained by planting an early maturing variety. Gluyas Early and Noongar have given the best returns for this purpose.

### OAT VARIETY TRIAL.

This experiment has been conducted for the past eight years. The variety Mulga, an early dual purpose oat, is used as control. This trial includes only mid-season and early varieties, as the late maturing varieties have proved unsuitable for the district. The experiment comprised both hay and grain sections, and included seven varieties.

The yields obtained from both the hay and grain sections are as follows:—

#### OAT VARIETY TRIAL.

##### Grain Section.

Planted 24th April, 1930.			Seed—40lb. per acre.			Superphosphate—150lb. per acre.		
Variety.	Maturity.	Computed Yield per Acre.			Average Yields per acre, 1930.	Percentage Yields per acre, 1930.	Percentage Yields per acre, up to 1929	
		Section 1.	Section 2.	Section 3.				
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%	
Mulga ...	Early ...	39 8	35 8	32 8	35 21	100	100	
Gidgee ...	Midseason ...	48 16	34 0	28 32	37 3	104	64	
Guyra ...	Midseason ...	44 32	38 32	33 8	38 37	103	82	
Mulga ...	Early ...	39 32	*	36 0	37 36*	100	100	
Mulga ...	Early ...	38 16	34 24	37 0	36 27	100	100	
Palestine ...	Early ...	47 16	41 32	38 24	42 24	116	98	
Belar ...	Midseason ...	35 0	28 24	30 0	31 8	82	61	
Mulga ...	Early ...	39 32	34 24	40 0	38 5	100	100	
Mulga ...	Early ...	38 24	31 16	35 24	35 8	100	100	
Burts Early (P. 1724)	Early ...	32 32	28 8	26 0	29 0	82	...	
Burts Early (P. 1494)	Early ...	45 32	41 32	42 32	43 19	115	80	
Mulga ...	Early ...	41 24	36 0	35 32	37 32	100	100	

\* Average of two plots only.

##### Hay Section.

Planted 24th April, 1930.			Seed—40lb. per acre.			Superphosphate—150lb. per acre.		
Variety.	Maturity.	Computed Yield per Acre.		Average Yield per acre, 1930.	Percentage Yield per acre, 1930.	Percentage Yield per acre, up to 1929.		
		Section 1.	Section 2.					
		cwt. qrs. lbs.	cwt. qrs. lbs.	cwt. qrs. lb.	%	%		
Mulga ... ..	Early ... ..	58 2 8	55 1 12	56 3 24	100	100		
Gidgee ... ..	Midseason ...	76 1 12	79 1 12	77 3 12	137	93		
Guyra ... ..	Midseason ...	52 0 16	56 0 0	54 0 8	101	92		
Mulga ... ..	Early ... ..	52 3 4	54 0 16	53 1 24	100	100		
Mulga ... ..	Early ... ..	55 3 4	59 2 0	57 2 16	100	100		
Palestine * ...	Early ... ..	57 0 16	57 2 16	57 1 16	100	...		
Belar ... ..	Midseason ...	55 0 24	57 0 0	56 0 12	102	90		
Mulga ... ..	Early ... ..	54 3 20	55 2 0	55 0 24	100	100		
Mulga ... ..	Early ... ..	52 2 8	56 0 8	54 1 8	100	100		
Burts Early (P. 1724)	Early ... ..	64 0 8	69 3 12	66 3 24	123	...		
Burts Early (P. 1494)	Early ... ..	56 0 8	56 1 4	56 0 20	98	90		
Mulga ... ..	Early ... ..	56 2 16	57 2 8	57 0 12	100	100		

\* Not planted in hay section previous to 1930.

This year, to facilitate the harvesting operations, the layout of this experiment was modified, and in consequence the average yields of previous years are not shown. The percentage results up to 1929 are, however, included for comparison. This year the yields obtained from all varieties for both hay and grain are very satisfactory. It will be noticed in the results for hay that the highest yield was obtained from the midseason variety, Gidgee, whilst for grain the highest yields were obtained from the early maturing varieties Palestine and Burts Early.

## FIELD EXPERIMENTS WITH WHEAT, 1930.

### CHAPMAN EXPERIMENT FARM.

I. THOMAS, Superintendent of Wheat Farms,

and

F. L. SHIER, B.Sc.(Agric.), Farm Manager.

The land in which the experiments were conducted varied from typical jam (*Acacia acuminata*) country to that of lighter timber country and had been cleared some years previously.

The past season was a rather adverse one for wheat-growing at this farm. The total rainfall for the year was 1,965 points, of which 1,856 points fell during the growing period. Such a heavy rainfall during these months has only been exceeded previously four times in twenty-five years.

The following is the rainfall for 1930, together with the 25 years' average:—

Year.	Jan.	Feb.	Mar.	Apr.	Growing Periods.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1930	...	...	34	57	117	915	460	159	121	84	1,856	14	4	1,965
Average, 25 years	26	48	65	44	234	438	399	263	162	90	1,592	29	22	1,826

No rain of any consequence fell until 9th May, and in view of past experience it was necessary to delay seeding until the rains had germinated the weed seeds. As an indication of the lateness of the season less than half the average rainfall for the period January-May had been recorded by the end of May. No less than 915 points fell during June, resulting in boggy and water-logged soil conditions which further delayed seeding operations and retarded the growth of crops already planted, particularly those in the low-lying portions of the paddocks. July was also a very wet month, but with the advent of warmer and drier conditions in August the growing conditions improved.

### TIME OF SEEDING EXPERIMENT.

This experiment was commenced in 1923 and has been planted each year since with the early variety Gluyas Early, but owing to the plots being destroyed by fire in 1924 and other factors interfering with the results in 1925 and 1926 the results were not obtained for those years. Commencing in 1928, the mid-season variety Nabawa was included in the experiment.

Each variety was planted as a separate experiment, the Gluyas Early being planted in mid-May, June and July, and Nabawa in mid-April, May and June.

The land was ploughed during July, 1929, with a mouldboard plough and was springtyne cultivated in October, and further cultivations were necessary in March and April to obtain the desired tilth prior to seeding the April plots.

All the Gluyas Early plots were again cultivated when the May section was planted. The June and July plots received a further cultivation at the time the June section was planted, and the July plot was again cultivated prior to seeding.

The Nabawa plots were treated in a similar manner, that is, as each section was planted the remaining plots not planted were cultivated also. This insured the ground being free of weeds and in good tilth.

## TIME OF SEEDING EXPERIMENT.

Variety—Nabawa.

Seed—60lb. per acre.

Superphosphate 112lb. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928-30.	Percentage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
April 14th ... ..	bus. lb. 6 16	bus. lb. 7 12	bus. lb. 6 56	bus. lb. 8 8	bus. lb. 7 52	bus. lb. 7 17	% 65	bus. lb. 8 56	% 80
May 16th ... ..	10 16	11 36	10 40	11 36	11 36	11 9	100	11 14	100
June 16th ... ..	11 12	11 52	9 20	10 8	8 48	10 16	92	10 31	94

Variety—Gluyas Early.

Seed—60lb. per acre.

Superphosphate—112lb. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1923-30.	Percentage Yields, 1923-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
May 16th ... ..	bus. lb. 11 12	bus. lb. 11 52	bus. lb. 10 8	bus. lb. 11 20	bus. lb. 12 16	bus. lb. 11 22	% 100	bus. lb. 16 2	% 100
June 16th ... ..	12 8	13 20	13 20	12 32	12 32	12 46	112	13 35	85
July 16th ... ..	7 12	7 28	6 32	5 4	4 48	6 13	55	8 22	52

The results of these years' trials are influenced to a large extent by the nature of the season, particularly with the early variety Gluyas Early. The average results for the previous seven years (1923-29) indicated that for this variety the May planting gave the best returns, the yields falling off considerably as the planting was delayed. This year the effect of the very heavy June rains was such that the growth of the May sowing was retarded to such an extent that the plants never wholly recovered. However, the average results for eight years indicate in no uncertain manner that for normal seasons May is the best month for planting the early variety Gluyas Early.

The results with the mid-season variety confirm those of the previous seven years, with the exception that the April-sown plots, the average yield of which was below that of previous years. This was due to the unfavourable wet conditions which checked the early sown crops.

## RATE OF SEEDING EXPERIMENT.

This experiment is carried out with a sparse stooling variety, S.H.J., and a free stooling variety, Nabawa, the object being to ascertain the most economical rate at which to plant the wheat crop. This experiment has been conducted continuously since 1923. In 1926, however, the results of the free stooling variety were influenced by other factors, and hence are not included in the averages.

The land was ploughed in July, 1929, with a mouldboard plough and spring-tine cultivated in October and prior to seeding the Nabawa plots in May. The S.H.J. plots received a further cultivation before being seeded. A good germination was obtained.

Planted on 16th May, 1930.

Variety—Nabawa.

Superphosphate—150lb. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per- centage Yields, 1930.	Average Yields per acre, 1923-30.	Per- centage Yields, 1923-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
60lb. ... ..	15 28	16 32	13 20	11 36	10 40	13 31	97	15 10	99
45lb. ... ..	15 12	15 44	13 12	12 48	12 48	13 57	100	15 17	100
90lb. ... ..	17 52	17 20	15 4	14 24	15 28	16 2	115	16 13	106

Planted on 6th June, 1930.

Variety—S.H.J.

Superphosphate—150lb. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per- centage Yields, 1930.	Average Yields per acre, 1923-30.	Per- centage Yields, 1923-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
60lb. ... ..	17 52	14 24	14 24	14 32	11 52	14 37	110	16 27	105
45lb. ... ..	14 40	13 36	11 20	14 48	11 52	13 15	100	15 38	100
90lb. ... ..	15 20	15 4	14 8	14 16	12 16	14 13	107	16 55	108

The results obtained with the sparse stooling variety indicate that it is an advantage to increase the rate of seeding above 45 lbs. per acre.

With the free stooling variety Nabawa both the results for this year and the average results for the previous years show that higher yields are obtained on this class of soil when heavy rates of seed are sown.

#### TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

This experiment was commenced in 1928 with the object of determining whether, when heavy dressings of superphosphate are used, it would be economical to apply part or all of this fertiliser when cultivating the fallowed land during late summer or early autumn, thus enabling seeding operations to be expedited.

To suit the requirements of this experiment three plots were used and each section was repeated five times.

The land on which the experiment was conducted was ploughed with a heavy mouldboard plough in July the previous year. It was cultivated with a spring-tine cultivator during October and again in March when the fertiliser was applied, and also when the experiment was planted.

The detailed results obtained this year, together with the average results for the three years the experiment has been in progress, are shown hereunder:—

#### TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 19th May, 1930.

Variety—Nabawa.

Seed—60lb. per acre.

Time of Application of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per- centage Yields, 1930.	Average Yields per acre, 1928-30.	Per- centage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
75lb. in March; 150lb. at seeding	11 44	9 20	10 48	10 24	13 4	11 4	95	13 23	105
225lb. in March ...	12 56	11 12	11 44	11 36	10 22	11 36	100	12 43	100
150lb. in March; 75lb. at seeding	13 28	11 4	11 52	10 32	11 12	11 38	100	13 1	102

The experiment has not been conducted sufficiently long enough for definite conclusions to be derived.



The results this year do not agree with those of the previous years, which indicated that the yield was increased when the greater part of the superphosphate was applied at seeding time.

### RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to ascertain the most profitable rates of superphosphate to apply to the wheat crop.

To meet the requirements the experiment was designed so that the three-plot system could be maintained. It was therefore divided into two sections, viz:—

Section 1, consisting of three plots which received, respectively, 300 lbs., 150 lbs., and 225 lbs. of superphosphate per acre.

Section 2, consisting of three plots which received, respectively, no superphosphate, 150 lbs., and 75 lbs. of superphosphate per acre.

The land was ploughed with a mouldboard plough in July, 1930, and was cultivated with a springtyne cultivator in October and prior to seeding.

The results of the experiment are shown in the following table:—

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT NO. 1.

Planted on May 20th, 1930.

Variety—Nabawa.

Seed—60lb. per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929-30.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
300lb. ... ..	bus. lb. 9 28	bus. lb. 10 56	bus. lb. 11 4	bus. lb. 12 0	bus. lb. *	bus. lb. 10 52	% 90	bus. lb. 12 57	% 101
150lb. ... ..	9 44	12 8	11 20	14 56	*	12 2	100	12 51	100
225lb. ... ..	9 12	11 4	11 20	16 8	*	11 56	99	13 34	106

\* Results not included owing to proximity to trees.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT NO. 2.

Planted on May 19th, 1930.

Variety—Nabawa.

Seed—60lb. per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929-30.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
No Superphosphate ...	bus. lb. 12 48	bus. lb. 12 8	bus. lb. 12 48	bus. lb. 13 44	bus. lb. 13 52	bus. lb. 13 4	% 96	bus. lb. 10 34	% 85
75lb. ... ..	14 32	13 36	11 52	14 8	12 56	13 25	99	11 33	93
150lb. ... ..	13 36	13 52	13 44	13 36	12 56	13 33	100	12 25	100

It was not possible to conduct this experiment at this farm on land to which superphosphate had not been applied previously. Consequently the yields of the plots receiving no superphosphate this year would benefit by the residual effect of the superphosphate previously applied. As the experiment will be planted on the same land each year, this residual effect will eventually disappear.

### SEASONAL PLANTING EXPERIMENT.

The objects of this experiment are:—

1. To ascertain the most suitable month to plant the Late, Mid-season, Early and Very Early maturing varieties of wheat.

2. To determine the most prolific of each of the above types.

To meet the requirements of the experiment three sections were needed, viz.:—

- (a) Section 1. Planted in April, representing early planting.
- (b) Section 2. Planted in May, representing mid-season planting.
- (c) Section 3. Planted in June, representing late planting.

Each section planted in its respective month was repeated five times: all plots eventually harvested for grain.

The standard mid-season variety Nabawa was planted in the control plots in all sections.

The land on which the experiment was planted was ploughed with a mould-board plough in August, 1929, and springtyne cultivated in September.

*April planting.* The soil was cultivated prior to seeding on 16th April, in addition to the cultivations already outlined.

#### SEASONAL PLANTING EXPERIMENT.

##### *April Planting.*

Planted on 16th April, 1930.

Seed—60lb. per acre.

Superphosphate—112lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Per-centage Yields, 1928-30
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Yandilla King ...	Late ...	4 48	4 48	4 8	5 20	5 12	4 51	61	76
Nabawa ...	Midseason ...	8 8	8 24	6 48	9 12	7 12	7 57	100	100
Sutton ...	Late ...	5 28	7 4	7 36	11 36	7 28	7 50	99	*
Beneubbin ...	Midseason ...	8 56	10 8	10 40	13 44	10 40	10 50	160	*
Nabawa ...	Midseason ...	7 4	6 40	6 16	7 52	6 0	6 46	100	100
Gluyas Early ...	Early ...	8 32	7 36	7 12	9 36	7 20	8 3	119	102

\* Planted 1930 only.

The very heavy winter rains retarded the growth of the plants, and consequently adversely affected the yields. The new mid-season variety, Beneubbin, which was planted for the first time this year, gave comparatively good yields. The new late maturing variety Sutton was only slightly below the yield of the control variety Nabawa, but considerably better than the late variety, Yandilla King.

*May planting.* In addition to the cultivations outlined, the land was again cultivated prior to seeding on 22nd May.

##### *May Planting.*

Planted on 22nd May, 1930.

Seed—60lb. per acre.

Superphosphate—112lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Per-centage Yields, 1928-30
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Yandilla King ...	Late ...	8 40	8 8	9 12	10 0	10 0	9 12	86	92
Nabawa ...	Midseason ...	9 36	9 20	11 4	11 44	12 0	10 45	100	100
Sutton ...	Late ...	11 36	10 56	12 32	13 36	13 12	12 22	115	*
Beneubbin ...	Midseason ...	13 4	10 40	12 16	13 44	12 48	12 30	152	*
Nabawa ...	Midseason ...	10 40	9 4	10 0	10 56	10 32	10 14	100	100
Gluyas Early ...	Early ...	10 48	10 32	10 48	12 48	11 4	11 12	109	97
Geeralyng ...	Very Early ...	12 16	11 36	11 28	12 8	10 0	11 30	113	97
Nabawa ...	Midseason ...	10 0	10 16	9 36	11 4	10 0	10 11	100	100
Comeback ...	Early ...	8 56	9 28	8 40	9 28	7 52	8 53	87	88†
Carrabin ...	Early ...	9 4	9 20	9 44	10 8	9 4	9 28	94	98
Nabawa ...	Midseason ...	9 44	9 20	10 16	10 56	9 52	10 2	100	100
Merredin ...	Early ...	9 52	10 0	11 52	10 0	8 48	10 6	101	102
S.H.J. ...	Early ...	9 44	9 36	9 52	10 16	8 32	9 36	97	102
Nabawa ...	Midseason ...	8 32	9 36	10 16	11 28	9 52	9 57	100	100
Noongaar ...	Very Early ...	9 12	6 56	8 48	9 4	6 48	8 10	82	79

† Planted 1930 only.

† Average two years, 1929-30.

Slightly higher yields were obtained in this section on account of being freer of weeds. The outstanding variety this year was the mid-season maturing variety Bencubbin, while Sutton and Geeralying, late and very early maturing varieties respectively, gave good returns. The average results for the three years the experiment has been conducted show comparatively uniform yields in this section.

*June planting.* Owing to weed growth it was necessary further to cultivate the land in May and prior to seeding on 17th June, resulting in a clean seed bed.

*June Planting.*

Planted on 17th June, 1930.

Seed -60lb. per acre.

Superphosphate -112lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1928-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Geeralying ...	Very Early...	13 12	10 16	14 32	14 0	11 12	12 38	94	90
Nabawa ...	Midseason ...	12 8	11 20	15 28	15 52	12 32	13 28	100	100
Bencubbin ...	Midseason ...	13 44	13 4	17 4	16 40	13 44	14 51	110	*
Gluyas Early ...	Early ...	12 32	12 24	13 12	12 56	12 8	12 38	93	92
Nabawa ...	Midseason ...	12 56	13 28	13 20	15 12	12 48	13 33	100	100
Comeback ...	Early ...	11 44	10 56	10 16	10 56	10 0	10 46	80	*
Carrabin ...	Early ...	12 48	11 20	11 12	11 20	11 44	11 41	87	*
Nabawa ...	Midseason ...	13 12	13 4	13 52	13 44	13 4	13 23	100	100
Merredin ...	Early ...	12 24	10 40	10 56	12 56	12 16	11 50	88	90
S.H.L. ...	Early ...	14 0	11 28	11 4	14 24	13 52	12 58	94	93
Nabawa ...	Midseason ...	14 32	11 44	14 32	14 0	14 0	13 46	100	100
Noongaar ...	Very Early ...	0 20	8 8	7 28	9 12	8 40	8 34	62	81

\* Planted 1930 only.

With the exception of Bencubbin, none of the varieties yielded better than the control variety. The sparse stooling varieties gave poor returns. This cannot be accounted for, as it would be expected that the quick-growing varieties, when planted so late in the season, should show to advantage.

## FIELD EXPERIMENTS WITH WHEAT AND OATS, 1930.

### WONGAN HILLS LIGHT LANDS FARM.

I. THOMAS, Superintendent of Wheat Farms, and  
A. R. VENTON, Farm Manager.

The past season was more favourable for the growth of the crop than that of the previous year; although the rainfall was again below the average, it was more evenly distributed.

The following table shows the monthly rainfall for 1929 and 1930 as recorded at the farm, together with the averages for the past 17 years as officially recorded at the Wongan Hills township, four miles distant.

Year.	Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for Year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total		
1930 ...	7	...	53	92	66	367	321	149	90	55	1,048	1	1,299
1929 ...	22	217	85	...	261	426	172	140	35	141	1,175	38	1,541
17 years' average ...	44	55	97	62	196	300	273	195	126	94	1,191	41	1,538

Useful rains fell in April, and those varieties planted during that month obtained a good start. The latter part of May was warm and dry, and as a result a little malting occurred in those portions of the crop planted after the first week in May.

The land on which the experiments were conducted was virgin country prior to being fallowed in 1929, consisted mainly of the smokebush and tussocky types of sand plain. It was ploughed from June to early August, 1929, with a disc implement (Sundercut), cross cultivated with the same implement during August and September, and again cultivated with the same implement in March and early April. Prior to seeding it was tandem disc cultivated. Excepting where the requirements of an experiment necessitated otherwise, the cultural details for all the experiments were as outlined. Where the Rates of Superphosphate and Time of Application of Superphosphate Experiments were planted, the ground was scrub-raked during January and February.

#### TIME OF SEEDING EXPERIMENT.

This experiment is being conducted to determine the most suitable month for planting the wheat crop in this district.

The early maturing variety, Gluyas Early, and the midseason-maturing variety, Nabawa, were used, the former being planted mid-May, June, and July, and the latter in April, May, and June.

The plots sown in April germinated well and made good growth, and were healthy and robust throughout the season. Owing to the dry conditions during the latter half of May, the May sown plots did not germinate until 12th June, and were somewhat uneven. Until early spring growth was slow, although healthy. The general appearance improved rapidly in spring.

The June sown plots were poor and spindly throughout the season, and did not improve much in spring. Although little more than a fortnight later than the May sown plots in actual growth, the difference was very marked.

The July sown plots were very much poorer throughout the season than the June plots.

#### TIME OF SEEDING EXPERIMENT.

Variety—Nabawa.

Seed—45lb. per acre.

Superphosphate—150lb. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928-30.	Percentage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
April 16th ... ..	bus. lb. 16 40	bus. lb. 16 8	bus. lb. 16 8	bus. lb. 14 16	bus. lb. 14 56	bus. lb. 15 38	% 121	bus. lb. 16 13	% 109
May 16th ... ..	13 52	13 20	13 36	12 0	11 52	12 56	100	14 50	100
June 17th ... ..	8 40	9 28	9 4	8 16	8 16	8 45	68	6 57	47

Variety—Gluyas Early.

Seed—45lb. per acre.

Superphosphate—150lb. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928-30.	Percentage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
June 17th ... ..	bus. lb. 7 44	bus. lb. 8 40	bus. lb. 9 20	bus. lb. 9 28	bus. lb. 9 20	bus. lb. 8 54	% 66	bus. lb. 7 29	% 53
May 16th ... ..	11 52	12 16	13 52	14 16	15 4	13 28	100	14 0	100
July 15th ... ..	3 20	3 36	4 24	4 0	3 28	3 46	28	4 58	35

These results again confirm in no uncertain manner those of former years, viz., it is essential that seeding should be completed before the end of May.

## RATE OF SEEDING EXPERIMENT—WHEAT.

As was the case in previous years, the experiment was conducted with two varieties, Nabawah (midseason maturing), representing the free stooling and S.H.J. (early maturing), representing the sparse stooling types respectively.

The germination of Nabawa was fair, but the warm dry spell during the latter half of May induced upward growth at the expense of stooling. Early in the season the lightest sowing appeared rather thin, but as the season advanced practically no difference could be seen.

When mature, the lightest sowing was slightly taller, but in general appearance there was practically no other difference.

Although planted on 16th May, the S.H.J. did not germinate until 12th June, owing to insufficient moisture. Consequently germination was not as good as usual, and stooling and growth generally were very poor indeed. There was not much difference between the two heavier rates of seeding at any time throughout the season.

## RATE OF SEEDING EXPERIMENT.

Planted on 29th April, 1930.

Variety—Nabawa.

Superphosphate—150lb. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1925-30.	Percentage Yields, 1925-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
60lb. ... ..	bus. lb. 12 48	bus. lb. 12 32	bus. lb. 13 20	bus. lb. 13 20	bus. lb. 13 12	bus. lb. 13 2	% 100	bus. lb. 15 2	% 103
45lb. ... ..	12 32	13 12	13 12	13 20	12 48	13 1	100	14 37	100
90lb. ... ..	13 4	13 28	13 20	13 4	13 12	13 14	102	14 54	103

Planted on 16th May, 1930.

Variety—S.H.J.

Superphosphate—150lb. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1925-30.	Percentage Yields, 1925-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
60lb. ... ..	bus. lb. 8 24	bus. lb. 8 40	bus. lb. 8 0	bus. lb. 8 16	bus. lb. 7 36	bus. lb. 8 11	% 106	bus. lb. 12 18	% 103
45lb. ... ..	8 8	7 44	8 8	7 20	7 28	7 46	100	11 58	100
90lb. ... ..	8 48	8 40	8 24	8 32	8 40	8 37	111	12 37	105

These results confirm those of previous years, viz., that with a free stooling variety of wheat no advantage is gained by seeding more than 45 lbs. of seed per acre. With a sparse stooling variety, however, the rate may be increased above 45 lbs. with some little advantage, but no benefit is derived by planting at a rate greater than 60 lbs. per acre.

## RATE OF SEEDING EXPERIMENT—OATS.

As was the case for the similar experiment with wheat, this was planted with both a free and a sparse stooling variety, and the land also was prepared identically with that for the wheat experiment.

Germination and growth of both varieties were very good. There was little difference between the plots throughout the season. The Algerian, although slow growing, compared with Burts, was healthy and even, and made rapid growth in late spring. The yields obtained, however, did not come up to expectations.

## RATE OF SEEDING OATS EXPERIMENT.

Planted on 29th April.

Variety—Algerian.

Superphosphate—150lb per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1926-30.	Per-centage Yields, 1926-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
45lb. ... ..	bus. lb. 14 16	bus. lb. 14 32	bus. lb. 12 24	bus. lb. 12 32	bus. lb. 12 0	bus. lb. 13 13	% 105	bus. lb. 13 11	% 111
30lb. ... ..	13 24	13 16	12 0	11 32	12 24	12 27	100	11 37	100
60lb. ... ..	14 8	12 32	13 0	12 32	12 32	13 5	103	13 14	112

Planted on 1st May.

Variety—Burt's Early.

Superphosphate 150lb. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1926-30.	Per-centage Yields, 1926-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
45lb. ... ..	bus. lb. 11 16	bus. lb. 12 32	bus. lb. 13 0	bus. lb. 13 16	bus. lb. 13 8	bus. lb. 12 30	% 106	bus. lb. 14 6	% 101
30lb. ... ..	11 0	11 8	12 16	12 24	13 8	12 3	100	13 38	100
60lb. ... ..	13 8	13 32	13 16	12 24	13 32	13 4	111	14 18	104

This year's results confirm the average results of the past four years, namely, that no benefit is derived by increasing the rate over 45 lbs. per acre with a late variety like Algerian.

With the sparse stooling variety, the results this year show that increased yields are obtained by the heavier rates of seeding.

The average results for the five years the experiment has been conducted, however, show that the increased yields do not compensate for the increased amount of seed required for planting.

## TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to determine whether, when heavy dressings of superphosphate are applied, it would be profitable to apply part or whole of the amount when cultivating the fallowed land during the late summer and early autumn.

For the purposes of the experiment, three plots were required.

Plot 1 received 75 lbs. in March and 150 lbs. at seeding.

Plot 2 was treated as control and received the whole 225 lbs in March.

Plot 3 received 150 lbs. in March and 75 lbs. at seeding.

Growth generally was healthy and even. The warm spell during the latter half of May forced upward growth somewhat at the expense of stooling.

At maturity the whole experiment was fairly even in height and general appearance, although the control plots seemed less dense when closely examined.

## TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 23rd April, 1930.

Variety—Nabawa.

Superphosphate—225lb. per acre.

Seed—45lb. per acre.

Time of Application of Superphosphate.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1928-30.	Per-centage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
75lb. in March ; 150lb. at seeding	bus. lb. 14 56	bus. lb. 15 44	bus. lb. 16 16	bus. lb. 16 40	bus. lb. 16 16	bus. lb. 15 58	% 111	bus. lb. 17 19	% 117
225lb. at seeding ...	13 44	13 20	15 36	15 4	14 32	14 27	100	14 47	100
150lb. in March ; 75lb. at seeding	14 48	15 36	15 44	16 0	16 32	15 44	109	16 16	110

These results confirm those of last year, viz., that yields are decreased when all or portion of the superphosphate is not applied at seeding time.

### RATE OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to determine the most profitable amount of superphosphate to apply on this type of country.

Two sections of 15 plots each were planted. In No. 1 section the rates of superphosphate were 150 lbs., 225 lbs., and 300 lbs. per acre; and in No. 2, 75 lbs., 150 lbs., and no superphosphate, each being repeated five times.

Germination throughout the experiment was fairly even, but from the time the plants were just above the ground, the plots without superphosphate made absolutely no growth until the spring and many of the plants died. Very few of the plants produced grain, and were only from 4in. to 6in. high.

There was no visible difference between the three heavy dressings during the season, although at maturity there was a very slight difference in favour of the two heaviest dressings. Excepting those plots which received no superphosphate, growth was healthy and even throughout the season. The warm spell during the latter half of May forced upward growth, somewhat at the expense of stooling.

#### RATE OF SUPERPHOSPHATE EXPERIMENT.

##### No. 1 Section.

Planted on 23rd April, 1930.

Variety—Nabawa.

Seed—45lb. per acre.

Rate of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929-30.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
225lb. ... ..	bus. lb. 15 28	bus. lb. 15 44	bus. lb. 15 36	bus. lb. 16 8	bus. lb. 15 52	bus. lb. 15 46	% 103	bus. lb. 12 22	% 105
150lb. ... ..	14 56	14 48	15 20	15 44	16 0	15 22	100	11 54	100
300lb. ... ..	15 36	15 12	15 36	16 0	16 32	15 47	103	12 30	104

##### No. 2 Section.

Rate of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929-30.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
No super. ... ..	bus. lb. ...	bus. lb. ...	bus. lb. ...	bus. lb. ...	bus. lb. ...	bus. lb. ...	% ...	bus. lb. ...	% ...
150lb. ... ..	15 44	15 20	14 32	15 20	15 12	15 14	100	...	...
75lb. ... ..	11 44	12 32	12 56	12 48	12 24	12 29	82	...	...

This year's results again show that although it is advantageous to apply considerably more than 75 lbs. of superphosphate per acre on this class of land, it is not profitable, due to the prevailing price of wheat, to exceed an application of 120 lbs. per acre.

### SEASONAL PLANTING EXPERIMENT.

The objects of the experiment are:—

1. To ascertain the most suitable month to plant the Late, Midseason and Early maturing varieties of wheat.
2. To determine the most prolific of each of the above types.

To meet the requirements of this experiment three sections were needed, viz.:—

- (a) Section 1, planted in April, representing Early planting.
- (b) Section 2, planted in May, representing Midseason planting.
- (c) Section 3, planted in June, representing Late planting.

Each section planted in its respective month was repeated five times, all plots being eventually harvested for grain.

The soil was mainly of the smokebush type, but was rather more sandy and loose than the average.

*April Planting.*—Germination was fairly good, but growth was forced upwards somewhat by the warm dry climatic conditions during the latter half of May. There was little difference at first between varieties, but the later ones gradually fell behind the remainder. Growth generally was healthy throughout the season. Gluyas Early made the most rapid growth, and was inclined to lodge at maturity. Bencubbin suffered somewhat from the excessive wet in July, but soon recovered, and at maturity had slightly the best general appearance.

*May Planting.*—Although planted at the middle of May, germination did not take place until 12th June. Stooling was poor, and growth throughout the season was slow. There was very little difference between the varieties, although the early ones gradually went ahead. At maturity all varieties were very short. Both Noon-gaar and Merredin lodged badly and were difficult to harvest. Geeralying and Merredin were inclined to shed a little after a strong wind. Bencubbin and Nabawa had the best general appearances, the former being slightly the better of the two.

*June Planting.*—Germination was uneven, while stooling and growth generally were very poor. Although only a fortnight later in actual growth, all varieties were very much inferior to the May sowing. There was very little difference between varieties throughout the season, and at maturity all were very short.

#### SEASONAL PLANTING EXPERIMENT.

##### *April Planting.*

Planted on 17th April, 1930.

Seed—45lb. per acre.

Superphosphate—150lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Per-centage Yields, 1928-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Yandilla King ...	Late ...	13 36	14 0	14 24	14 0	14 8	14 2	100	99
Nabawa ...	Midseason ...	14 32	14 0	14 8	14 0	13 52	14 6	100	100
Baroota Wonder ...	Late ...	13 44	13 44	13 28	12 56	11 52	13 9	93	97
Early									
Bencubbin ...	Midseason ...	17 20	17 4	17 20	17 36	16 16	17 7	132	*
Nabawa ...	Midseason ...	13 44	13 12	12 56	12 56	12 0	12 58	100	100
Gluyas Early ...	Early ...	14 8	15 4	15 4	14 48	13 36	14 32	112	96

\* Planted 1930 only.

##### *May Planting.*

Planted on 15th and 16th May, 1930.

Seed—45lb. per acre.

Superphosphate—150lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Per-centage Yields, 1928-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Yandilla King ...	Late ...	11 28	11 4	10 24	9 28	8 8	10 16	92	90
Nabawa ...	Midseason ...	13 36	11 52	11 12	10 8	8 24	11 2	100	100
Baroota Wonder ...	Late ...	10 56	10 16	9 12	8 24	7 12	9 12	83	87
Early									
Bencubbin ...	Midseason ...	16 0	14 48	13 44	12 56	10 32	13 36	124	*
Nabawa ...	Midseason ...	12 48	12 24	11 20	10 24	8 8	11 1	100	100
Gluyas Early ...	Midseason ...	12 8	12 0	11 12	10 8	7 44	10 38	97	113
Merredin ...	Early ...	10 16	10 8	9 36	8 24	7 4	9 6	96	93
Nabawa ...	Midseason ...	10 40	10 16	9 28	9 20	7 44	9 30	100	100
Carrabin ...	Early ...	12 56	11 44	10 32	10 32	7 28	10 38	112	101
S.H.J. ...	Early ...	11 44	10 16	8 40	8 32	6 56	9 14	91	86
Nabawa ...	Midseason ...	12 32	11 4	10 16	9 20	7 28	10 8	100	100
Geeralying ...	Very Early ...	11 44	9 52	8 8	7 20	6 0	8 27	85	78
Nabawa ...	Midseason ...	12 56	10 32	10 16	8 16	7 28	9 54	100	100
Noongaar ...	Very Early ...	9 4	7 36	6 40	5 44	5 20	6 53	70	65

\* Planted 1930 only.



## June Planting.

Planted on 17th June, 1930.

Seed—45lb. per acre.

Superphosphate—150lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields per acre, 1930.	Per-centage Yields, 1928-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Geeralyng ...	Very Early...	4 48	5 20	5 20	5 20	6 32	5 28	85	88
Nabawa ...	Midseason ...	5 28	6 24	6 8	6 16	7 44	6 24	100	100
Bencubbin ...	Midseason ...	6 32	6 48	7 4	8 8	8 40	7 26	116	†
Carrablu ...	Early ...	5 44	5 52	5 52	5 44	7 20	6 6	89	92
Nabawa ...	Midseason ...	5 20	6 24	6 40	7 52	8 0	6 51	100	100
Glinyas Early ...	Early ...	5 12	5 20	6 16	6 8	7 12	6 2	88	91
Merredin ...	Early ...	6 8	5 4	6 8	6 24	7 20	6 13	93	*94
Nabawa ...	Midseason ...	6 40	6 0	6 24	6 48	7 28	6 40	100	100
S.H.J. ...	Early ...	5 44	5 36	5 36	6 48	7 20	6 13	93	83
Noongar ...	Very Early	4 0	3 4	3 20	5 20	6 0	4 5	61	75

\* Average 2 years.

† Planted 1930 only.

These results again emphasise the necessity for early planting on this class of soil.

The early part of the winter being unusually mild, the May planting did not suffer as much as it would have done under normal conditions, but the yields are much below the early sowing.

## OAT VARIETY TRIAL.

As in former years, this experiment consisted of eight sections, three of which were cut for hay and the balance harvested for grain.

Germination was fair, but growth was very slow. During the early part of the season there was little difference between varieties, excepting that Belar and Algerian were somewhat backwards. As the season advanced this became more pronounced, and Belar in particular contained much red and yellow flag. Gidgee also was slightly affected.

Owing to the position of the early maturing variety, Palestine, it was not possible to harvest it when ready and consequently the results obtained are not included for comparison. However, during the growing period, this variety gave promise of yielding as well as the control variety.

The variety Gidgee ripened very irregularly and lodged as soon as ripe. Belar improved at the end of the season. All varieties were short in the straw, and, as is usual with oats on new land, the yields were disappointing, as are shown by the following results:—

## OAT VARIETY TRIAL.

## Grain Section.

Planted on 6th and 7th May, 1930.

Seed—40lb per acre.

Superphosphate—150lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average per-centage Yields 1926-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Burts Early ...	Early ...	12 24	13 24	10 24	11 24	11 32	12 2	100	100
Mulga ...	Early ...	11 8	12 16	9 24	10 24	11 8	11 0	91	95
Belar ...	Midseason ...	11 16	12 0	10 8	10 16	9 24	10 29	93	*
Burts Early ...	Early ...	12 16	13 8	10 32	11 8	10 8	11 22	100	100
Burts Early ...	Early ...	13 8	13 0	11 16	11 0	10 32	11 35	100	100
Algerian ...	Late ...	14 8	14 24	12 8	11 32	11 16	12 34	103	115
Guyra ...	Midseason ...	12 0	12 24	10 8	9 32	9 24	10 34	96	107
Burts Early ...	Early ...	12 16	12 32	11 0	10 24	9 32	11 13	100	100
Burts Early ...	Early ...	12 0	13 0	10 24	11 8	10 16	11 18	100	100
Lachlan ...	Midseason ...	11 0	11 32	10 0	9 24	9 24	10 16	91	108
Burts Early ...	Early ...	12 8	11 24	10 32	10 16	9 24	10 37	100	100
Burts Early ...	Early ...	12 16	12 16	11 32	10 32	10 0	11 19	100	100
Gidgee ...	Midseason ...	10 8	9 24	9 16	8 32	8 16	9 11	81	*

\* Planted in 1930 only.

*Hay Section.*

Planted 6th and 7th May, 1930.

Seed—40lb. per acre.

Superphosphate—150lb. per acre.

Variety.	Maturity.	Computed Yield per Acre.			Average Yield per acre, 1930.	Percentage Yield 1930.	Average percentage Yield 1926-30.
		Section 1.	Section 2.	Section 3.			
		cwt. qrs. lb.	cwt. qrs. lb.	cwt. qrs. lb.	cwt. qrs. lb.	%	%
Burts Early ...	Early ...	20 2 8	17 1 4	13 3 20	17 1 1	100	100
Mulga ...	Early ...	18 1 4	13 0 24	13 0 8	14 3 12	86	110
Belar ...	Midseason ...	17 2 24	10 2 0	9 2 0	12 2 8	81	*
Burts Early ...	Early ...	15 0 24	15 1 20	13 1 12	14 2 19	100	100
Burts Early ...	Early ...	15 3 4	13 1 4	14 1 12	14 1 26	100	100
Algerian ...	Late ...	14 2 8	9 1 12	9 2 24	11 0 24	77	87
Guyra ...	Midseason ...	15 1 12	10 0 0	11 1 12	12 0 27	93	96
Burts Early ...	Early ...	14 3 12	12 2 16	12 0 8	13 0 21	100	100
Burts Early ...	Early ...	15 0 16	11 3 4	12 1 12	13 0 11	100	100
Lachlan ...	Midseason ...	11 0 8	8 0 0	8 0 8	9 0 5	69	96
Palestine ...	Early ...	12 3 4	10 2 8	7 3 12	10 1 17	85	*
Burts Early ...	Early ...	14 0 0	13 3 4	8 3 20	12 0 27	100	100
Burts Early ...	Early ...	16 1 4	13 0 0	10 1 12	13 0 24	100	100
Gidgee ...	Midseason ...	13 2 8	7 2 24	7 0 8	9 1 23	72	*

\* Planted in 1930 only.

As would be expected, owing to the low rainfall in the spring, the early maturing varieties gave the best hay returns. The average results for five years indicate that the early maturing variety, Mulga, is the most suitable for hay.

The late maturing variety, Algerian, which has given the best grain yields over the period that the experiment has been conducted, again yielded well this year, benefitting as it did by the rains in October, which came too late for the earlier maturing varieties.

**FIELD EXPERIMENTS WITH WHEAT, 1930.****SALMON GUMS EXPERIMENT FARM.**

I. THOMAS, Superintendent of Wheat Farms, and

L. G. SEINOR, Farm Manager.

The rainfall for the greater part of the past season was favourable for the growth of the wheat crops. The heavy rains which fell in March facilitated the preparation of a good seed bed in addition to assuring reserves of moisture in the subsoil. Seeding operations were carried out under ideal conditions, and the germination of the seed was excellent. Favourable growing conditions continued until the end of August. Light falls were recorded during September, but the crops did not derive full advantage from these because of the drying winds which were later experienced.

The monthly rainfall, as recorded at the farm for both years 1930 and 1929, together with the average for the past 12 years as recorded at Salmon Gums, one mile distant, is as follows:—

—	Jan.	Feb.	Mar.	Apr.	Growing Periods.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
At Farm, 1930 ...	...	...	312	162	269	156	92	230	73	17	837	14	298	1,623
At Farm, 1929 ...	106	65	73	26	125	207	159	163	21	35	710	150	43	1,173
Average, 1926-30 ...	33	35	203	99	133	113	139	167	80	88	720	40	74	1,204
Salmon Gums Town, 1919-30 ...	29	46	128	113	165	151	132	141	110	113	812	75	98	1,301

The area on which the experiments were planted originally carried silver mallee, silver bark, tea tree and other light mallee, and was cleared in 1926, fallowed 1927, and cropped in 1928. In preparation for the planting this year it was ploughed to a depth of 4in. with a disc-cultivating plough in June-July, 1929, cross ploughed in November, springtyne cultivated in January, and prior to seeding.

#### TIME OF SEEDING EXPERIMENT.

The object of this experiment is to determine the most suitable time for planting the wheat crop.

Two varieties were used, the midseason variety, Nabawa, being sown in mid April, May, and June, and the early variety, Gluyas Early, in mid May, June, and July.

Immediately prior to each planting, all plots not then planted received a further cultivation with a springtyne implement.

Germination was good throughout.

#### TIME OF SEEDING EXPERIMENT.

Variety—Nabawa.

Superphosphate—112lb. per acre.

Seed—45lb. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928-30.	Percentage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
April 12th ... ..	bus. lb. 16 0	bus. lb. 16 0	bus. lb. 16 24	bus. lb. 14 8	bus. lb. 17 20	bus. lb. 15 58	% 105	bus. lb. 14 14	% 107
May 12th ... ..	15 20	16 16	14 24	13 36	16 40	15 15	100	13 20	100
June 19th ... ..	10 0	10 8	10 24	9 44	10 56	10 14	67	7 41	58

Variety—Gluyas Early.

Superphosphate—112lb. per acre.

Seed—45lb. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928-30.	Percentage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
14th June ... ..	bus. lb. 15 20	bus. lb. 15 20	bus. lb. 15 44	bus. lb. 16 24	bus. lb. 15 20	bus. lb. 15 38	% 70	bus. lb. 12 9	% 70
14th May ... ..	19 28	18 48	19 36	20 0	19 20	19 26	100	17 27	100
14th July ... ..	11 28	12 16	11 36	13 12	11 20	11 58	62	9 32	55

This experiment again demonstrates that the yields of both early and mid-season varieties are considerably reduced when the crop is planted later than the month of May.

The Seeding Calendar for the Esperance Wheat Area, in which this farm is located, is as follows:—

Variety.	Maturity.	Northern.	Central.	Southern.
		Boete, Kumarl, Dowak and Salmon Goms.	Circle Valley, Red Lake, Grass Patch.	Treslove, Scaddan.
Yandilla King	Late ...	...	April 1 to 15 ...	April 1 to 21
Nabawa	Midseason ...	April 15 to May 7	April 15 to May 7	April 21 to May 21
Gluyas Early	Early ...	May 1 to 21 ...	May 1 to 21 ...	May 10 to 21
Noongaar	Very Early...	May 21 to 31 ...	May 21 to 31 ...	...

## RATE OF SEEDING EXPERIMENT.

This experiment is conducted to determine the most profitable rate of seeding the wheat crop.

Two varieties were used, Nabawa, representing the free stooling varieties, and Noongaar, representing the sparse stooling varieties.

The results obtained are set out below:—

## RATE OF SEEDING EXPERIMENT.

Planted on 11th May, 1930.

Variety—Nabawa.

Superphosphate—112lb. per acre.

Rate of Seed per acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928-30.	Percentage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
30lb. ... ..	bus. lb. 12 40	bus. lb. 12 24	bus. lb. 14 16	bus. lb. 14 40	bus. lb. 12 24	bus. lb. 13 17	% 90	bus. lb. 11 13	% 94
45lb. ... ..	14 40	14 40	14 32	15 20	14 16	14 42	100	11 54	100
60lb. ... ..	14 48	13 4	15 28	15 44	13 36	14 32	99	12 6	102

Planted on 14th May, 1930.

Variety—Noongaar.

Superphosphate—112lb. per acre.

Rate of Seed per acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928-30.	Percentage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
30lb. ... ..	bus. lb. 9 44	bus. lb. 12 56	bus. lb. 9 36	bus. lb. 11 20	bus. lb. 7 20	bus. lb. 10 11	% 79	bus. lb. 11 4	% 92
45lb. ... ..	12 48	12 56	13 4	12 24	13 4	12 51	100	12 3	100
60lb. ... ..	12 16	13 52	11 36	12 32	8 56	11 50	92	11 38	96

These results, as was the case the previous year, indicate that little or no advantage is derived from planting more than 45 lbs. of seed per acre.

## TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

This experiment is conducted in order to determine whether, when applying heavy dressings of superphosphate, it would be profitable to apply part or all of the fertiliser when cultivating the fallowed land in late summer or early autumn, thus allowing seeding operations to be expedited.

The tabulated results for 1930, together with the averages for the previous years, are as follow:—

## TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 9th May, 1930.

Variety—Nabawa.

Seed—45lb. per acre.

Time of Application of Superphosphate.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928-30.	Percentage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
150lb. in March; 75 lb. at seeding	bus. lb. 14 40	bus. lb. 15 28	bus. lb. 15 20	bus. lb. 17 20	bus. lb. 14 56	bus. lb. 15 33	% 104	bus. lb. 14 14	% 103
225lb. in March	15 52	14 8	14 40	14 56	15 28	15 1	100	13 46	100
75lb. in March; 150 lb. at seeding	14 24	15 52	17 36	14 40	14 24	15 23	102	14 57	109

The average results for the three years the experiment has been conducted show that the yields are decreased when a portion of the fertiliser is not applied at seeding time.

### RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

This experiment has been modified, and is now divided into two sections. This allows of the introduction of a plot receiving no superphosphate, and one receiving 300 lbs. per acre. The object of the experiment is to determine the most profitable amount of superphosphate to apply to the wheat crop.

#### RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT NO. 1.

Planted on 7th May, 1930.

Variety—Nabawa.

Seed—45lbs. per acre.

Rate of Application of Superphosphate per acre.	Computed Yield per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1929-30.	Per-centage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
300lb. ... ..	bus. lb. 14 40	bus. lb. 15 28	bus. lb. 14 40	bus. lb. 15 12	bus. lb. 16 16	bus. lb. 15 15	% 98	bus. lb. 14 10	% 106
150lb. ... ..	15 12	15 44	15 12	14 32	17 4	15 33	100	13 26	100
225lb. ... ..	14 32	13 44	15 4	15 52	14 40	14 46	95	14 27	108

#### RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT NO. 2.

Planted on 7th May, 1930.

Variety—Nabawa.

Seed—45lb. per acre.

Rate of Application of Superphosphate per acre.	Computed Yield per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1929-30.	Per-centage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
No Superphosphate ...	bus. lb. 6 56	bus. lb. 9 20	bus. lb. 8 0	bus. lb. 8 0	bus. lb. 8 56	bus. lb. 8 14	% 59	bus. lb. 6 37	% 45
150lbs.... ..	13 52	14 0	13 36	14 8	13 52	13 54	100	14 45	100
75lb. ... ..	12 32	12 48	12 48	13 44	11 36	12 42	91	13 32	92

These results, which are for two years only, show that the yields are increased when heavier rates of superphosphate are applied.

With the present value of wheat, however, applications in excess of 112 lbs. appear to cease to be profitable.

### SEASONAL PLANTING EXPERIMENT.

The objects of this experiment are:—

1. To ascertain the most suitable month to plant the late, midseason, early and very early maturing varieties of wheat.

2. To determine the most prolific of each of the above types.

To meet the requirements of the experiment three sections were made, viz.:—

- (a) Section 1, planted in April, representing early planting.
- (b) Section 2, planted in May, representing midseason planting.
- (c) Section 3, planted in June, representing late planting.

Each section planted in its respective month was repeated five times, all plots being eventually harvested for grain.

The standard midseason variety was planted in the control plots in all sections.

The land on which the experiment was planted was ploughed with a disc-cultivating plough in June-July, 1929, cross ploughed in November, and cultivated in January with a springtyne implement. It was again given a springtyne cultivation in April. The May and June plots were cultivated and cross cultivated and harrowed in May to destroy the self-sown wheat and oats. The June plots received a further working prior to seeding, which took place on 21st June. Germination was good in all plots, but the growth of the June section was very slow and backward. The following are the results:—

## SEASONAL PLANTING EXPERIMENT.

## APRIL PLANTING.

Seed—45lb. per acre.

Planted on 18th April, 1930.

Superphosphate—112lb. per acre.

Variety.	Maturity.	Computed Yield per acre.					Average yield per acre, 1930.	Average per-centage yield per acre, 1930.	Average per-centage yield per acre, 1928-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Yandilla King	Late	18 40	18 16	19 52	16 48	20 0	18 43	104	88
Nabawa	Midseason	15 20	17 28	18 16	19 4	19 28	17 55	100	100
Sutton	Late	18 48	18 56	18 56	19 20	20 56	19 23	108	...
Bencubbin	Midseason	20 8	21 52	24 32	22 24	23 28	22 20	126	...
Nabawa	Midseason	15 28	17 44	18 8	18 40	19 4	17 40	100	100
Gluyas Early	Early	14 0	16 48	13 36	12 48	15 12	14 29	81	84
Noongaar	Very Early	13 20	12 8	12 56	12 0	13 36	12 48	71	*74
Nabawa	Midseason	15 52	19 20	18 56	19 20	16 32	18 0	100	100

\* Average 2 years, 1929-30.

In this section the late maturing variety, Sutton, and the midseason variety, Bencubbin, which have been tried for the first time this year, have given encouraging results. The average results for the three years during which the experiment has been conducted indicate that for April planting the standard mid-season variety, Nabawa, is most suitable. Early maturing varieties are obviously unsuitable for early planting when intended to be harvested for grain.

## May Planting.

Planted on 19th May, 1930.

Seed—45lb. per acre.

Superphosphate—112lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Per-centage Yields, 1928-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Yandilla King	Late	12 8	16 40	16 56	12 48	12 48	14 16	90	78
Nabawa	Midseason	13 36	19 4	14 56	14 56	14 16	15 46	100	100
Sutton	Late	12 24	15 28	13 52	12 32	12 0	13 15	84	*
Bencubbin	Midseason	18 16	21 12	18 48	16 40	16 48	18 21	109	*
Nabawa	Midseason	18 16	19 20	17 28	15 20	13 44	16 50	100	100
Carrabin	Early	16 40	18 24	16 16	13 44	12 8	15 26	92	93
Merredin	Early	20 48	22 0	19 4	16 40	18 32	19 25	107	106
Nabawa	Midseason	19 36	19 52	18 16	16 56	16 16	18 11	100	100
Gluyas Early	Early	19 52	20 0	19 4	18 48	17 52	19 7	105	100
S.H.J.	Early	18 40	18 48	16 8	17 36	16 40	17 34	96	95
Nabawa	Midseason	18 40	19 52	16 32	20 40	15 36	18 16	100	* 100
Geeralying	Very Early	18 24	19 4	16 56	17 44	13 36	17 9	94	96
Noongaar	Very Early	19 12	18 24	18 24	16 40	12 56	17 7	95	101
Nabawa	Midseason	21 36	19 52	16 24	15 28	17 12	18 6	100	100

\* Planted 1930 only.

In this section also the variety, Bencubbin, gave very satisfactory results, whilst the late maturing varieties, Sutton and Yandilla King, yielded less than the controls. The results of the early maturing varieties, Merredin and Gluyas Early, indicate their suitability for planting during the month of May.

*June Planting.*

Planted on 21st June, 1930.

Seed—45lb. per acre.

Superphosphate -112lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Per-centage Yields, 1928-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Bencubbin ...	Midseason ...	12 24	12 40	14 24	14 48	14 0	13 39	115	•
Nabawa ...	Midseason ...	10 40	11 20	11 44	13 36	12 8	11 54	100	100
Carrabin ...	Early ...	10 0	11 12	10 16	12 8	11 20	10 59	92	94
Merredin ...	Early ...	10 56	12 16	10 48	12 8	10 24	11 18	94	101
Nabawa ...	Midseason ...	11 36	12 56	11 28	12 16	11 52	12 2	100	100
Gluyas Early ...	Early ...	13 12	12 48	10 8	11 12	13 36	12 11	101	109
S.H.A. ...	Early ...	8 40	10 32	9 12	10 8	9 52	9 41	77	83
Nabawa ...	Midseason ...	12 16	13 4	11 36	13 4	12 48	12 34	100	100
Geeralyng ...	Very Early ...	10 32	10 40	8 48	9 36	11 20	10 11	81	95
Noongaar ...	Very Early ...	13 12	12 56	10 32	12 0	13 20	12 24	98	112
Nabawa ...	Midseason ...	10 0	12 56	12 8	12 48	12 48	12 8	100	100

\* Planted 1930 only.

The new variety, Bencubbin, again gave the best returns, but it must be remembered that this is the first year it has been tried. Over the period which the experiment has been conducted, it has been demonstrated that if it is necessary to prolong the seeding into June, it would be safer to use the very early maturing variety, Noongaar, or the early variety, Gluyas Early. Attention is drawn to the comparatively low yields of all varieties in this section to the yields in the section planted in May. This confirms the conclusion advocated, viz., that the yields are more satisfactory when the seeding is completed during the month of May.

## FIELD EXPERIMENTS WITH WHEAT, 1930.

### VILGARN EXPERIMENT FARM.

I. THOMAS, Superintendent of Wheat Farms.

Since cropping operations have been carried out at the farm (these commencing in 1929), the rainfall during the growing periods has been below that of the average for Southern Cross (a distance of 8 miles West) for the past 40 years.

The monthly registrations at the farm for 1930, together with the average for the past three years, and the average as recorded at Southern Cross for the past 40 years are set out hereunder:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for year.	
					May.	June.	July.	Aug.	Sept.	Oct.				Total.
1930 ... ..	...	167	62	209	87	229	88	110	45	9	568	10	173	1,189
Average 3 years ...	43	95	58	86	177	150	104	75	31	25	565	101	77	1,025
Southern Cross average, 40 years ...	49	61	107	79	138	141	145	110	80	61	675	43	46	1,060

Following good rains during the months of February and March, copious rains were experienced in April, resulting in the subsoil becoming well supplied with moisture. These April rains caused seeding operations to be delayed, but after

the first week in May no further rain was recorded during that month, which enabled seeding to be proceeded with without interruption. Some anxiety, however, was caused by this prolonged dry period, as it was feared that malting of the seed would occur in the crops sown after the middle of May. This anxiety was relieved, by rains early in June. During the remainder of that month further good rains were recorded and owing to the mild climatic conditions which prevailed during July and August, the crops made vigorous growth. Unfortunately these favourable growing conditions did not continue into September. During this month the rainfall was scanty and several severe frosts occurred, combined with hot drying conditions during the day, which affected the crops. Little or no rain was experienced in October, so that they matured under adverse conditions, when it became apparent that the yields of earlier expectations would not be realised.

The land on which the experiments were conducted was originally timbered with salmon gum and gimlet, and was cleared in 1928. During June and July, 1929, in preparation for planting, it was ploughed with a disc cultivating plough to a depth of 4 inches. In September it was cultivated with a springtyne implement and was again cultivated with the same implement in February, after rain and prior to seeding.

Unless otherwise stated, these cultural operations refer to the land on which the experiments set out below were planted.

#### TIME OF SEEDING EXPERIMENT.

The object of this experiment is to determine the most suitable month to plant the wheat crop.

Two varieties of different maturity were used: Nabawa, a mid-season; and Gluyas Early, an early-maturing variety.

The Nabawa plots were planted in mid-April, May and June; and the Gluyas Early were planted mid-May, June and July.

The April sown plots germinated after good rain on the 19th and 20th. The May sown plots of both varieties did not germinate until after rain on 2nd June. All plots made good early growth and stooled well, except those planted in June and July.

#### TIME OF SEEDING EXPERIMENT.

Variety:-Nabawa.

Superphosphate--112lb. per acre.

Seed--30lb. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928-30.	Percentage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
14th April ... ..	bus. lb. 21 20	bus. lb. 21 4	bus. lb. 22 32	bus. lb. 23 36	bus. lb. 24 8	bus. lb. 22 32	% 119	bus. lb. 18 37	% 110
14th May ... ..	17 20	18 24	19 44	19 44	19 44	18 59	100	16 52	100
16th June ... ..	6 24	7 52	8 0	8 48	9 20	8 8	43	8 20	49

Variety:-Gluyas Early.

Superphosphate--112lb. per acre.

Seed--30lb. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928-30.	Percentage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
14th May ... ..	bus. lb. 19 44	bus. lb. 19 52	bus. lb. 20 40	bus. lb. 19 52	bus. lb. 20 24	bus. lb. 20 6	% 100	bus. lb. 16 45	% 100
16th June ... ..	11 44	12 32	13 44	14 56	14 32	13 30	67	10 53	65
15th July ... ..	4 32	4 24	4 16	2 56	3 4	3 50	19	4 10	25



The results this year and the average results over the three years the experiment has been conducted, show that it is of advantage to plant the mid-season variety, Nabawa, during April rather than in May. By delaying planting until June, unprofitable returns can be expected.

Both this year's returns and those of the three years' average show also that early maturing varieties are most prolific when sown in May, and that the yields decrease considerably should planting be delayed after this month.

### RATE OF SEEDING EXPERIMENT.

The object of this experiment is to determine the most economic rate of seeding with (a) a mid-season free stooling, and (b) an early and sparse stooling variety.

For the former the variety Nabawa, and for the latter the variety Noongaar, were used.

The germination was good on all plots after rain early in June, and owing to the mild climatic conditions which prevailed good growth was made. The general appearance of all crops was very even, and no difference in yield was apparent to the eye.

Planted on 5th May, 1930.

Variety--Nabawa.

Superphosphate--112lb. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per- centage Yields, 1930.	Average Yields per acre, 1928-30.	Per- centage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
22lb. ... ..	bus. lb. 19 12	bus. lb. 17 4	bus. lb. 19 20	bus. lb. 21 4	bus. lb. 17 12	bus. lb. 18 46	% 100	bus. lb. 17 17	% 100
42lb. ... ..	20 8	17 28	20 16	18 56	17 20	18 50	100	17 14	100
35lb. ... ..	17 36	17 36	19 4	19 12	17 44	18 14	97	16 38	96

Planted on 15th May, 1930.

Variety--Noongaar.

Superphosphate--112lb. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per- centage Yields, 1930.	Average Yields per acre, 1928-30.	Per- centage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
22lb. ... ..	bus. lb. 20 40	bus. lb. 21 12	bus. lb. 21 44	bus. lb. 23 4	bus. lb. 23 44	bus. lb. 22 5	% 100	bus. lb. 14 27	% 102
42lb. ... ..	21 44	21 28	22 56	22 0	22 40	22 10	100	14 13	100
35lb. ... ..	21 12	21 12	22 0	22 32	20 16	21 26	97	14 14	100

The average results for the past three years in the early and sparse stooling variety section show very little variation, although the lowest rate has a slight advantage. The variation this year in the rate of 35 lbs. per acre cannot be accounted for.

In the free stooling variety section the results are somewhat similar, and here again the variation in the rate of 35 lbs. per acre cannot be accounted for. It shows, however, the necessity for continuing the experiment for a number of years before arriving at definite conclusions.

### RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to determine the most economical rate to apply superphosphate to the wheat crop.

In 1929 it was decided to enlarge this experiment so as to ascertain in what proportion a greater rate of superphosphate, up to 300 lbs., would affect the yield, although it was not anticipated that it would be profitable to apply that quantity. It was also decided to include a zero plot having no superphosphate.

In order to preserve the three-plot system this experiment was divided into two sections, in each of which, plots treated with 150 lbs. of superphosphate per acre were regarded as controls. Thus in Section 1 the rates of 300 lbs. and 225 lbs. per acre were compared with the control rate of 150 lbs. per acre, and in Section 2 the rates of no superphosphate and 75 lb. were compared with the control rate.

#### RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT, No. 1.

Planted on 7th May, 1930.

Variety—Gluyas Early.

Seed—30lb per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per- centage Yields, 1930.	Average Yields per acre, 1929-30.	Per- centage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
300lb. ... ..	bus. lb. 22 56	bus. lb. 22 24	bus. lb. 21 52	bus. lb. 21 4	bus. lb. 20 32	bus. lb. 21 46	% 103	bus. lb. 13 18	% 93
150lb. ... ..	24 56	22 0	20 32	19 52	18 48	21 14	100	14 21	100
225lb. ... ..	22 40	19 4	20 56	21 12	19 28	20 40	97	13 20	92

#### RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT, No. 2.

Planted on 7th May, 1930.

Variety—Gluyas Early.

Seed—30lb. per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per- centage Yields, 1930.	Average Yields per acre, 1929-30.	Per- centage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
No superphosphate ...	bus. lb. 15 28	bus. lb. 11 16	bus. lb. 13 12	bus. lb. 14 24	bus. lb. 13 4	bus. lb. 14 5	% 62	bus. lb. 10 17	% 61
150lb. ... ..	22 8	22 8	23 20	21 44	23 44	22 37	100	16 55	100
75lb. ... ..	12 8	20 8	20 8	19 20	18 40	18 3	80	14 12	84

The average results for the two years the experiment has been conducted show that increased yields are obtained when superphosphate is applied up to 150 lbs per acre.

With the prevailing prices of wheat, however, the maximum profitable rate of application appears to be reached when 100 to 112 lbs. is applied.

### TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to determine whether, when heavy dressings of superphosphate are applied, it would be profitable to apply part or whole of the amount when cultivating the fallowed land during the late summer and early autumn.

For the purpose of the experiment, three plots were required, and the various rates and times of application of the superphosphate are shown in the accompanying table of results—

#### TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 7th May, 1930.

Variety—Gluyas Early.

Seed—30lb. per acre.

Time of Application of Superphosphate.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928-30.	Percentage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
150lb. at seeding : 75lb. in March	bus. lb. 20 56	bus. lb. 18 56	bus. lb. 19 12	bus. lb. 20 24	bus. lb. 21 44	bus. lb. 20 14	% 104	bus. lb. 17 7	% 109
225lb. in March	18 24	19 36	19 4	19 28	20 24	19 23	100	15 41	100
75lb. at seeding : 150lb. in March	17 36	15 52	19 12	20 48	20 40	18 50	97	16 14	103

The results for last year, and also the average for the three years, confirm the previous conclusion, viz., the yields can be expected to decrease as the proportion of superphosphate applied at seeding time is decreased.

#### SEASONAL PLANTING EXPERIMENT.

The objects of the experiment are:—

- (1) To ascertain the most suitable month to plant the Mid-season, Early and Very Early maturing varieties of wheat;
- (2) To determine the most prolific of each of the above types.

To meet the requirements of this experiment, three sections were needed, viz.:—

- (a) Section 1, planted in April, representing Early planting;
- (b) Section 2, planted in May, representing Mid-season planting;
- (c) Section 3, planted in June, representing Late planting.

Each section planted in its respective month was repeated five times, all plots being eventually harvested for grain.

*April Planting.*—At the time of planting, the soil was in an excellent and moist condition, and consequently a good germination resulted. Although retarded during the latter part of May all the plots made strong growth during the early winter months. The early maturing variety Noongaar came into ear during July.

#### SEASONAL PLANTING EXPERIMENT.

##### *April Planting.*

Planted on 16th April.

Seed—30lb. per acre.

Superphosphate—112lb. per acre.

Variety.	Maturity.	Computed Yield per Acre.					Average Yields per acre, 1930.	Average per-centage Yields per acre, 1930.	Average per-centage Yield per acre* 1928-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
Noongaar ...	Very Early...	bus. lb. 1 28	bus. lb. 0 56	bus. lb. 1 52	bus. lb. 1 52	bus. lb. 1 28	bus. lb. 1 31	% 10	% 75
Nabawa ...	Midseason ...	16 0	13 28	16 16	13 36	17 20	15 20	100	100
Gluyas Early ...	Early ...	10 56	9 44	11 20	8 40	10 56	10 19	67	88
Bencubbin ...	Midseason ...	19 20	20 0	19 28	19 4	21 4	19 47	132	...
Nabawa ...	Midseason ...	14 40	14 48	14 16	15 20	16 0	15 1	100	100

These show in no uncertain manner the inadvisability of planting both the very early and early maturing varieties during April should the resulting crop be intended for grain. It is interesting to notice that very promising results were obtained from the mid-season variety, Bencubbin, which was included in these trials this year for the first time.

*May Planting.*—Although immediate germination of the seed resulted, the growth of the plants was retarded during the latter part of the month, but with favourable conditions following, the plants made vigorous growth.

*May Planting.*

Planted on 13th May.

Seed—30lb. per acre.

Superphosphate—112lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yield per acre, 1930.	Average percentage Yield per acre, 1930.	Average percentage Yield per acre, 1928-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
Noongaar ...	Very Early	bus. lb. 22 56	bus. lb. 21 20	bus. lb. 20 56	bus. lb. 17 28	bus. lb. 14 8	bus. lb. 19 22	% 108	% 113
Nabawa ...	Midseason ...	21 4	18 8	18 24	13 52	*	17 52	100	100
Gluvas Early...	Early ...	21 12	18 8	19 52	16 40	18 8	18 48	105	107
Bencubbin ...	Midseason ...	20 16	20 56	20 24	16 40	17 4	19 4	106	/
Nabawa ...	Midseason ...	19 52	19 4	19 28	14 24	16 48	17 55	100	100
Merredin ...	Early ...	22 8	18 0	17 44	15 12	16 16	17 52	100	89
Carrabin ...	Early ...	18 40	18 16	18 0	12 32	13 12	16 8	100	98
Nabawa ...	Midseason ...	14 32	18 24	16 8	13 44	18 16	16 13	100	100
Geeralying ...	Very Early...	15 28	17 28	17 20	11 52	14 40	15 22	95	101
S.H.J. ...	Early ...	14 16	17 20	14 40	11 28	14 56	14 32	98	88
Nabawa ...	Midseason ...	10 48	18 32	14 16	12 32	17 52	14 48	100	100

\* Discarded owing to loss of grain during harvesting.

† Bencubbin planted 1930 only.

The average results for the three years the experiment has been conducted show that the highest yields were obtained from the very early maturing variety, Noongaar, and the early variety Gluvas Early, which indicates that they are the most suitable varieties for the May planting. In this year's results the variety Bencubbin is also shown to advantage.

*June Planting.*—This section suffered most by the scanty rains during spring, which caused the plants to mature under adverse conditions.

*June Planting.*

Planted on 17th June, 1930.

Seed—30lb. per acre.

Superphosphate—112lb per acre.

Variety.	Maturity.	Computed Yield per Acre.					Average Yield per acre, 1930.	Average percentage Yield per acre, 1930.	Average percentage Yield per acre, 1928-30.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
Noongaar ...	Very Early	bus. lb. 17 52	bus. lb. 17 12	bus. lb. 16 24	bus. lb. 18 56	bus. lb. 16 8	bus. lb. 17 18	% 163	% 137
Nabawa ...	Midseason ...	10 40	10 0	10 24	12 56	9 12	10 38	100	100
Gluvas Early...	Early ...	12 48	12 0	12 40	14 24	11 12	12 37	119	117
Bencubbin ...	Midseason ...	13 12	11 20	12 32	15 4	10 32	12 32	131	...
Nabawa ...	Midseason ...	10 0	8 24	9 52	10 40	8 56	9 34	100	100
Merredin ...	Early ...	10 24	8 48	8 56	10 48	8 48	9 33	100	99
Carrabin ...	Early ...	13 36	10 8	10 48	13 44	12 40	12 11	117	...
Nabawa ...	Midseason ...	11 28	8 56	8 56	13 20	9 28	10 26	100	100
Geeralying ...	Very Early...	12 24	8 24	10 32	15 20	12 0	11 44	113	107
S.H.J. ...	Early ...	11 44	8 48	9 44	10 40	8 32	9 54	105	92
Nabawa ...	Midseason ...	11 36	6 48	9 20	10 32	9 4	9 28	100	100

Both this year's results and the average results for the three years show the variety Noongaar to be outstanding, whilst all varieties have yielded better than the control variety Nabawa.

It is quite evident that should it be necessary for the planting season to extend later than the month of May, the most suitable variety to plant is Noongaar.

## FIELD EXPERIMENTS WITH WHEAT, 1930.

### DAMPAWAH EXPERIMENT FARM.

I. THOMAS, Superintendent of Wheat Farms, and  
F. GISHUBL, Farm Manager.

The farm is situated 30 miles East of Perenjori, being formerly a portion of Karara Station, on the fringe of the Lower Murchison.

The soil is a red friable loam, uniform in appearance, and was originally timbered mainly with york gum, giant mallee, karara, and mulga scrub.

This is the first crop grown on this land, which was cleared during 1928 and the early part of 1929. After the burn a large quantity of ashes remained over the whole area. It was ploughed during the winter months (July-August) of 1929, with a disc cultivating plough 3-4 inches deep. Immediately after ploughing it was cultivated with a springtyne implement. The seed was planted with a combined cultivator drill at the rate of 45 lbs. per acre. Superphosphate was applied at 112 lbs. per acre.

The following table shows the rainfall registered at the farm since it was established, together with the number of days on which rain fell during the year under review.

Year.	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for Year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1928 ... ..	*	*	*	*	164	94	238	142	71	34	743	6	156	†
1929 ... ..	17	220	64	N//	267	234	60	62	18	33	674	120	...	1,095
1930 ... ..	—	—	93	123	48	404	100	93	22	41	768	31	54	1,069
No. of falls, 1930 ...	—	—	8	9	2	16	12	10	2	3	45	3	3	68

\* No records.

† Incomplete.

Although the rainfall during the growing period this year was greater than the previous year, the spring rains were somewhat similar, being scanty and insufficient for the crops to mature normally.

After a very dry period from the middle of November, 1929, 93 points of rain were recorded in March, spread over 8 days. Both before and after this rain hot dry weather conditions prevailed.

Prior to the middle of April, when 123 points of rain were recorded, no moisture could be detected in the subsoil as the rain which fell the previous month evaporated very rapidly. The registrations during the month of May were scanty and caused anxiety, as some of the crops already sown were above ground, and showed signs of distress and urgent need of rain.

The continuous and copious rains during June relieved the position, reviving patches of the crop on which the seed had appeared to have malted. There were, however, isolated patches which were affected by the seed malting.

Excellent growing conditions prevailed throughout July and the early part of August, and until the end of the third week of the latter month the crops looked very promising. Unfortunately the seasonable rains terminated abruptly at this time, resulting in the ears of the plants being unable to leave the sheath normally or wilting before reaching maturity. Harvesting of the crops for hay was commenced 16th September, and for grain on 23rd October.

### TIME OF SEEDING EXPERIMENT.

The object of this experiment is to determine the most suitable month to plant the wheat crop.

Two varieties of different maturities were used—Nabawa, a midseason, and Gluyas Early, an early maturing variety.

The Nabawa plots were planted mid-April, May, and June, and the Gluyas Early were planted mid-May, June, and July.

The germination of the seed on all plots was satisfactory, and plants made strong growth until the middle of August. From then on, due to the scanty rainfall, all plots showed signs of distress, the plot planted in June with Nabawa failing to produce grain.

The results are tabulated below:—

TIME OF SEEDING EXPERIMENT.									
Variety -Nabawa.			Superphosphate—112lb. per acre.			Seed- 45lb. per acre.			
Planted.			Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.
			Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
			bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%
April 15th	...	...	4 24	5 20	6 40	6 40	6 24	5 54	180
May 15th	...	...	2 32	2 48	3 36	3 44	3 44	3 17	100
June 15th	...	...	...	...	...	...	...	...	...

TIME OF SEEDING EXPERIMENT.									
Variety-- Gluyas Early.			Superphosphate—112lb. per acre.			Seed- 45lb. per acre.			
Planted.			Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.
			Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
			bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%
June 15th	...	...	3 36	4 0	4 40	4 8	2 48	3 50	40
May 15th	...	...	8 32	9 20	10 32	10 8	9 36	9 38	100
July 15th	...	...	2 40	2 48	3 12	2 32	2 0	2 38	27

Although these results are for one year only and the yields obtained are low, they emphasise the necessity for planting the different maturing varieties at the correct time.

### RATE OF SEEDING EXPERIMENT.

The object of this experiment is to ascertain the most economical rate at which to plant the wheat crop with—

- (a) a Midseason, free stooling variety;
- (b) an Early, sparse stooling variety.

To meet the requirements of the former, the standard variety, Nabawa, was used, and for the latter, the variety S.H.J.

Each variety, treated as a separate experiment, was planted in different sections.

## RATE OF SEEDING EXPERIMENT.

Planted on 21st April, 1930.

Variety—Nabawa-Free stooling.

Superphosphate—112lb. per acre.

Rate of Seeding.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1929-30.	Per-centage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
30lb. ... ..	5 12	8 8	6 24	8 40	8 8	7 18	101	10 38	107
45lb. ... ..	4 56	6 0	8 56	8 8	7 44	7 9	100	9 57	100
60lb. ... ..	4 40	6 8	8 16	6 24	5 52	6 16	88	9 11	92

Planted on 18th April.

Variety—S.H.J.

Superphosphate (22%)—108lb. per acre.

Rate of Seeding.	Computed Yields per Acre.					Average Yields per acre, 1929.	Per-centage Yields, 1929.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%
30lb. seed per acre ...	14 15	13 31	14 15	13 53	14 22	14 3	102
45lb. seed per acre ...	14 0	12 40	14 8	13 53	14 8	13 46	100
60lb. seed per acre ...	13 9	12 55	12 11	13 9	14 8	13 6	95

The results of the midseason variety, Nabawa, which is for two years only, confirm the results obtained at the other experiment farms, viz., that no advantage is obtained when the heavier rates of seeding are sown. Unfortunately, owing to misadventure, an accident occurred when planting the plots of the sparse stooling variety, which upset the experiment for this year, and no comparative results were obtained. The results obtained the previous year are tabulated below. These also show that no advantage was gained by heavy rates of seeding.

## TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

This experiment was designed to determine whether when heavy dressings of superphosphate are used it would be profitable to apply part or all of the fertiliser when cultivating the fallowed land during late summer or early autumn, so that seeding operations can be expedited.

## TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 5th May, 1930.

Variety—Gluyas Early  
Seed—45lb. per acre.

Superphosphate—225lb. per acre.

Time of Application of Superphosphate.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1929-30.	Per-centage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
150lb. per acre sown in March; 75lb. per acre sown with seed	4 40	4 24	5 12	5 20	6 56	5 18	103	13 46	104
225lb. sown in March	4 16	3 52	5 36	5 52	6 16	5 10	100	13 14	100
75lb. in March; 150lb. at seeding	4 40	4 16	5 52	6 32	6 0	5 28	106	14 2	106

The results of this year's trials, and also the results for the two years this experiment has been conducted at this farm, show that the yields are greater when the major portion of the fertiliser is applied at seeding time.

These results are in accord with those obtained from similar experiments conducted at the other experiment farms.

#### RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

This experiment is divided into two sections in order to test the effects of applying the following amounts of superphosphate per acre with the wheat crop:—

##### Section 1—

No super.

150 lbs. per acre (control).

120 lbs. per acre.

##### Section 2—

75 lbs. per acre.

150 lbs. per acre (control).

225 lbs. per acre.

#### RATE OF SUPERPHOSPHATE EXPERIMENT—No. 1.

Planted on 6th May, 1930.

Variety—Gluvas Early.

Seed—45lbs./acre

Rate of Application of Superphosphate per acre.	Computed Yield per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
120lb. ....	bus. lb. 8 8	bus. lb. 8 48	bus. lb. 8 56	bus. lb. 7 44	bus. lb. 9 28	bus. lb. 8 37	% 106	% *
150lb. ....	7 12	8 32	7 36	8 40	8 48	8 10	100	100
Nil ....	4 56	5 36	6 0	5 4	5 4	5 20	65	42

\* This rate not applied in 1929.

#### RATE OF SUPERPHOSPHATE EXPERIMENT—No. 2.

Planted on 6th May, 1930.

Variety—Gluvas Early.

Seed—45lb. per acre.

Rate of Application of Superphosphate per acre.	Computed Yield per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
75lb. ....	bus. lb. 8 32	bus. lb. 7 44	bus. lb. 7 28	bus. lb. 6 56	bus. lb. 9 20	bus. lb. 8 0	% 130	% 98
150lb. ....	5 52	5 4	6 8	6 32	7 12	6 10	100	100
225lb. ....	4 8	4 32	4 48	6 0	5 52	5 4	82	91

The results are for one year only, and no definite conclusion can be arrived at. However, they do not confirm the results obtained from the other Experiment Farms which show that the wheat yields were increased by the heavier applications of superphosphate.



## SEASONAL PLANTING EXPERIMENT.

The objects of the experiment are—

(1) To ascertain the most suitable month to plant the Late, Midseason, Early and Very Early maturing varieties of wheat.

(2) To determine the most prolific of each of the above types.

To meet the requirements of this experiment, three sections were needed, viz.:—

(a) Section 1, planted in April, representing Early planting.

(b) Section 2, planted in May, representing Midseason planting.

(c) Section 3, planted in June, representing Late planting.

Each section planted in its respective month was repeated five times, all plots being eventually harvested for grain.

The standard Midseason variety, Nabawa, was planted in the control plots in all sections.

## SEASONAL PLANTING EXPERIMENT.

## APRIL PLANTING.

Planted—10th April.

Seed—45lb. per acre.

Superphosphate—112lb. per acre

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
Bencubbin ...	Midseason ...	bus. lb. 6 48	bus. lb. 6 40	bus. lb. 7 44	bus. lb. 6 40	bus. lb. 8 8	bus. lb. 7 17	% 108
Nabawa ...	Midseason ...	5 28	6 24	7 36	6 32	7 28	6 42	100
Carrabin ...	Early ...	9 52	9 36	10 0	9 4	10 16	9 46	146
Gluvas Early ...	Early ...	10 0	10 8	11 4	11 28	11 52	10 54	165
Nabawa ...	Midseason ...	6 16	6 8	6 24	5 12	9 4	6 37	100
Noongaar ...	Very Early ...	11 28	11 4	10 32	10 8	11 36	10 58	160

## MAY PLANTING.

Planted—15th May.

Seed—45lb. per acre.

Superphosphate—112lb. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
Noongaar ...	Very Early ...	bus. lb. 12 52	bus. lb. 10 56	bus. lb. 11 12	bus. lb. 13 20	bus. lb. 13 28	bus. lb. 12 34	% 225
Nabawa ...	Midseason ...	6 0	6 8	4 8	5 44	5 36	5 31	100
S.H.J. ...	Early ...	8 24	7 4	7 20	8 0	8 56	7 57	144
Gluvas Early ...	Early ...	9 12	7 28	8 0	9 20	9 36	8 43	162
Nabawa ...	Midseason ...	5 28	3 52	5 12	6 32	5 52	5 23	100
Merredin ...	Early ...	7 36	6 32	9 52	9 12	9 26	8 24	159
Carrabin ...	Early ...	7 44	4 0	6 32	5 44	...	6 5	116
Nabawa ...	Midseason ...	7 12	3 20	4 8	5 52	5 15	5 15	100
Bencubbin ...	Midseason ...	6 48	3 28	5 12	6 16	6 48	5 42	103
Nabawa ...	Midseason ...	5 44	3 28	5 44	6 24	6 24	5 33	100
Geeralyng ...	Very Early ...	8 32	8 40	10 24	8 32	9 36	9 9	165

In view of the scanty spring rainfall, it is not surprising that the Early and Very Early maturing varieties were outstanding in the April planting, and whilst the Early maturing varieties also yielded better than the control Midseason variety, Nabawa, in the May planting the Very Early variety, Noongaar, was most outstanding.

In the June planting some of the varieties failed to form grain. Very low and unsatisfactory yields were obtained from the remainder, but of these the variety Noongaar again gave the highest yield.

## NITROGEN-FIXING BACTERIA FOR LEGUMINOUS PLANTS.

### PURE CULTURES OBTAINABLE FROM PLANT PATHOLOGY BRANCH.

H. A. PITTMAN, B.Sc.Agr.,

Plant Pathologist.

Pure cultures of the nitrogen-fixing bacteria which form nodules on the roots of species of the pea, clover, and bean family (*Leguminosae*), may be obtained on application to the Plant Pathologist, at the prices indicated below.

These bacteria, after forming nodules on the roots of leguminous plants, enable the infected plants to draw directly on the inexhaustible supplies of free nitrogen in the air. Although, in the absence of such nitrogen-fixing bacteria, legumes may make quite satisfactory growth on soils containing abundance of combined-nitrogen, in the form, for instance, of humus compounds, sulphate of ammonia, etc., the full benefit of growing such plants can only be obtained when the appropriate bacteria are present.

A common method of introducing the bacteria onto a new field, or farm, is to inoculate the new area with soil from a field which has previously grown successful crops of the kind under consideration, and on the roots of which abundant nodules have been found. This method is quite satisfactory in most cases, but has the disadvantage of sometimes introducing plant diseases or weed seeds. If attempted it should be carried out preferably during dull weather or late in the afternoon, so as to minimise the harmful effect of sunlight on the bacteria.

In newly-settled areas so far remote from fields already inhabited by the desirable bacteria that the obtaining of suitable soil is not easily, or economically, practicable, the artificial cultures will be found a great boon. They have been used in the past by many farmers in the South-West of this State, and particularly in the Group Settlement areas, with great success.

The bacteria are supplied on agar slopes in test tubes, or in eight-ounce medicine bottles containing about eight times the quantity of the smaller size. To cover cost of materials, glassware, containers, postage, etc., the following small charges are made:—

(a) Test-tube size—1s. 6d.

(b) Medicine bottle size (containing 8 times the quantity in (a))—  
2s. 6d.

The contents of one tube will inoculate approximately 10 to 15 lbs. of small seed, such as lucerne or subterranean clover, and 20 to 30 lbs. of larger seed, such as peas or soy beans. The bottle size will treat about eight times the quantity of the test-tube size.

### DIFFERENT BACTERIA REQUIRED FOR DIFFERENT KINDS OF LEGUMES.

The same strain of bacteria will not inoculate every kind of leguminous plant. Thus trefoils and lucerne are inoculated by the same kind, but the lucerne kind will not inoculate clovers or peas.

The bacteria which may be obtained from the Department will inoculate the following groups of legumes. The members of each group are inoculated by the same kind of bacteria, but the plants mentioned in different groups require different bacteria.

*Group 1.*—Subterranean clover, white Dutch clover, perennial red clover ("cow grass"), Egyptian clover, and all other true clovers (*Trifolium spp.*).

*Group 2.*—Lucerne, white sweet clover, "King Island Melilot" ("Hexham scent"), medics, trefoils, and all other species of *Medicago* or *Melilotus*.

*Group 3.*—Garden pea, sweet pea, field pea, all kinds of vetches or tares, broad bean, lentil.

*Group 4.*—Lupins and serradella.

*Group 5.*—Soy beans.

### DIRECTIONS FOR USING THE PURE CULTURES.

Keep the tubes or bottles *unopened* and in a warm, dark, place until about to be used. The cultures are useful for at least one month after being received. In the cultures the bacteria appear as a whitish slime on the sloping surface of the agar (*i.e.*, the jelly-like material containing bacterial food).

#### *To inoculate the seeds with the cultures.*

The seeds should first be piled on a clean surface. Then take *one quarter pint* of fresh skimmed milk for every *tube*, or *one quart* of fresh skimmed milk for every *medicine bottle*, of culture. In the skim milk dissolve the soluble calcium phosphate supplied with every tube or bottle of culture.

Then transfer the whole of the agar contents of the tube, or bottle, to the skim milk and *thoroughly* mix the bacterial slime with the milk. When this has been done, pick out the lumps of agar (*i.e.*, the solid, whitish, jelly-like material). Rinse the tube or bottle out into the milk.

Now inoculate the seed by pouring a little of the inoculated milk on the heap of seed, from time to time, and thoroughly mixing until every seed is moistened. The seed should not, however, be made too wet. If any of the inoculated skim milk is left over it could be mixed up with water and spread on a few yards of soil where the seeds are to be planted. On the other hand, if there is not quite enough inoculated milk to thoroughly moisten all the seeds, the vessel which originally contained the inoculated skim milk may be rinsed out with further skim milk, and more added to the heap of seeds until, on repeated mixing, every seed is uniformly moistened with the inoculated milk.

If sweet skim milk is not available, a commercial brand of powdered skim milk, mixed up with water according to the maker's directions, or even plain water, may be used instead. The milk is better, however, as it causes better adherence of the bacteria to the seed on drying.

It usually takes about one quarter of a pint of milk to every 10 to 15 lbs. of small seeds such as lucerne, or 20 to 30 lbs. of large seed such as peas. The larger the seeds the less culture and skimmed milk required for inoculation, and *vice versa*.

### SOWING.

The seeds should be sown as soon as possible after inoculation. If the seeds are too wet to sow they should be allowed to dry in a shady place. Under no circumstances should the cultures or the inoculated seeds be left exposed to the sunlight, as it tends to destroy large numbers of the bacteria. For this reason, also, the seed should be drilled, or, if broadcast, should be at once harrowed in. The inoculated seed should not be sown at the same time as artificial fertilisers, as these may destroy the bacteria.

## FARMERS' FIELD TRIALS, 1930.

### EXPERIMENTS AT KONDININ.

A. S. WILD, B.Sc. (Agric.), Agricultural Adviser.

Two experiments with wheat were conducted during 1930 on the property of Mr. W. Trembath, Kondinin. They were—

1. A Wheat Variety Trial.
2. A Rate of Superphosphate Trial.

The location of the plots was about one mile distant from Kondinin townsite. They were planted on red morrel soil of a fairly fine texture. The land had been ploughed at the end of July, 1929, with a disc plough to a depth of four inches. During early October it was harrowed and springtyne cultivated, this latter operation being repeated during late October and again in April. The plots, each half acre in area, were subsequently planted on the 15th May with a combined cultivator-drill. Superphosphate (22 per cent.) was applied to the Variety Trial plots at the rate of 112 lbs. per acre, the rate of seed in each case being 45 lbs. per acre. In the Superphosphate Trial the standard early variety, Gluyas Early was planted in all plots.

The monthly rainfalls as recorded at Kondinin during the year, together with the averages, are as follow:—

	Jan.	Feb.	Mar.	Apr.	Useful Rains.							Nov.	Dec.	Total for year
					May.	June.	July.	Aug.	Sep.	Oct.	Total			
Kondinin ... ..	...	...	126	181	68	312	364	155	144	32	1,075	7	50	1,439
Average 13 years	40	62	100	105	182	228	219	157	117	82	985	73	38	1,403

Although no rain fell for the first three weeks subsequent to planting, the germination was fair.

The results from both experiments are shown hereunder:—

#### WHEAT VARIETY TRIAL.

Planted on 15th May.

Superphosphate -112lb. 22% per acre.

Seed -45lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.				Average Yields per acre.		Percentage Yields per acre.
		Section 1.		Section 2.				
		bus.	lb.	bus.	lb.	bus.	lb.	%
Nabawa ... ..	Midseason ... ..	24	54	22	8	23	31	72
Gluyas Early (Control)	Early ... ..	31	54	33	20	32	37	100
Carrabin ... ..	Early ... ..	22	58	22	52	22	55	70
S.H.J. ... ..	Early ... ..	22	18	22	44	22	31	75
Gluyas Early (Control)	Early ... ..	30	0	30	22	30	11	100
Noongaur ... ..	Very Early ... ..	...	...	...	...	...	...	...

## RATE OF SUPERPHOSPHATE TRIAL.

Planted 16th May.

Variety—Gluyas Early.

Seed—45lb. per acre.

Rate of Superphosphate per Acre.	Computed Yields per Acre.		Average Yield per acre.	Percentage Yield per acre.
	Section 1.	Section 2.		
150lb ... ..	bus. 31 lb. 40	buslb. 32 14	bus. 31 lb. 57	100
75lb. (Control) ... ..	30 26	28 8	29 17	100
225lb. ... ..	32 50	30 12	31 31	108

In the Variety Trial the control variety, Gluyas Early, shows to decided advantage. Both the varieties Carrabin and S.H.J. proved about equal to the standard midseason variety, Nabawa. Unfortunately the very early variety, Noon-gaar, lodged and tangled badly, and consequently the yields obtained cannot be taken for comparison.

In the Rate of Superphosphate Trial the rate of 225 lbs. per acre showed no advantage over the 150 lbs. per acre. The results from the trial confirm those conclusions derived from the results of similar experiments conducted at the Experiment Farm and elsewhere, viz. :—

1. The wheat crop is not "burnt off" by the application of the larger quantities of superphosphate.
2. That 75 lbs. of 22 per cent. superphosphate per acre is not sufficient for the most economical results, and therefore it is advisable to apply larger quantities—in years of normal wheat prices up to 150 lbs. per acre.

## TIME OF SEEDING EXPERIMENT AT NORTH WALGOOLAN.

H. RUDALL, Field Officer.

The object of this experiment conducted on the property of Mr. W. A. Graham, North Walgoolan, was to demonstrate the necessity for sowing wheats at the correct time, as well as to emphasise the consequences of seeding very late.

For the purpose of the trial two varieties of wheat were used, namely, Nabawa, the standard midseason maturing variety, and Gluyas Early, the standard early maturing variety. Nabawa was planted at intervals of one month, commencing the middle of April, viz., 14th April, 14th May, and 14th June, while Gluyas Early was planted on 14th May, 14th June, and 19th July. The plots, which were each half an acre in area, were duplicated.

The land on which the experiment was planted originally carried a forest of salmon gum, gimlet, and morrel, the soil being a fine red loam which was typical of the soils of the locality. The land was ploughed during the first week in June, 1929, to a depth of  $3\frac{1}{2}$  inches with an eight-furrow disc-cultivating plough. In August and September it received a cultivation with a springtyne implement, with harrows attached, and in November a further working with the same implement, without the harrows. It was harrowed in March, and the plots were planted with a combined cultivator-drill. This working produced an excellent seed bed, which was well consolidated, while the mulch was of desired tilth and free of weeds. In addition to the cultivations previously described, the May, June, and July plots received a further springtyne cultivation prior to seeding, to destroy weed growth.

The rainfall recorded up to the end of the growing period is shown in the following table:—

Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Total May-Oct.
0	4	126	198	60	395	130	162	130	24	901

The past season has been a good one. During May a dry hot spell was experienced, and the April and May plots were beginning to feel the want of rain when good falls were registered early in June, and, in fact, owing to the heavy June and July rains, the plots planted during these months were sown when the ground was very wet. The lack of finishing rains during October, a feature often experienced in this district, was again felt, 24 points being recorded. In consequence the late sown plots were at a disadvantage.

The results obtained are as hereunder:—

#### TIME OF SEEDING EXPERIMENT.

##### *Nabawa—Midseason Variety.*

Seed—45lb. per acre.

Superphosphate—85lb. per acre.

Planted.	Computed Yield per Acre.		Average Yield per acre.	Average Percentage Yield per acre.
	Section 1.	Section 2.		
	bus. lb.	bus. lb.	bus. lb.	%
April 14th ... ..	24 0	25 40	24 50	127
May 14th ... ..	19 40	19 20	19 30	100
June 14th ... ..	19 0	18 50	18 55	97

##### *Gluyas Early—Early Variety.*

Seed—45lb. per acre.

Superphosphate—85lb. per acre.

Planted.	Computed Yield per Acre.		Average Yield per acre.	Average percentage Yield per acre.
	Section 1.	Section 2.		
	bus. lb.	bus. lb.	bus. lb.	%
May 14th ... ..	24 20	24 20	24 30	100
June 14th ... ..	19 0	18 20	18 40	76
July 19th ... ..	8 0	7 40	7 50	32

Although this experiment has been conducted on this property for one year only, the data obtained shows a close uniformity with the results from similar trials in the Merredin Experiment Farm, which is located some thirty odd miles further West. The figures, in themselves, are a convincing argument, and they illustrate how very important it is to sow the right variety at its correct seeding period. Just as it spells failure to seed very late, so is it courting trouble by going to the other extreme and planting too early, with the result that such troubles as frost, septoria, etc., may either destroy the whole crop or considerably diminish the yield. So as to counteract this possible tendency of sowing too early, the following seeding calendar for the Walgoolan area is recommended:—

#### SEEDING CALENDAR.

##### WALGOOLAN AREA.

Variety.	Time to Plant.
Late maturing varieties, e.g., Yandilla King ... ..	Too late for district.
Midseason maturing varieties, e.g., Nabawa ... ..	April 15th to May 7th
Early maturing varieties, e.g., Gluyas Early ... ..	May 1st to May 21st
Very Early varieties, e.g., Noongaar ... ..	May 21st to May 31st

## TIME OF SEEDING EXPERIMENT AT SCADDAN.

G. L. THROSSELL, Dipl. Agric., Agricultural Adviser.

In response to a request from the Scaddan Settlers' Association, the Department of Agriculture this year conducted a Time of Seeding Experiment on the property of Messrs. Grigg Bros., Scaddan.

The object of the experiment was to determine the most suitable time to plant the wheat crop, as well as to provide an ocular demonstration of the folly of seeding too late. Because of the divergent views on the subject held by many settlers in this area, an experiment of this nature was necessary to emphasise the Departmental recommendations.

Three varieties were used, the late maturing variety Yandilla King being sown in April and May; the midseason variety, Nabawa, in April, May and June; and the early variety, Gluyas Early, in May, June and July. The plots, which were each half an acre in area, were duplicated. It was intended that the April plots should be sown on 15th April, but owing to rain, planting was delayed until the 24th.

The land on which the experiment was planted was a heavy clay soil which originally carried a dense growth of mallee, and which was typical of the soil of the Scaddan district. It was rolled and burnt in 1920, and had been cropped four times with wheat prior to 1930. This paddock is worked on a three-year rotation—fallow, wheat, pasture—the previous wheat crop being sown on fallow in 1927. For this year's crop it was ploughed with a disc cultivating plough in July, 1929, to a depth of 3-4 inches, worked across with the same implement in September, and received a springtyne cultivation in January and March. The heavy rains which fell after the March working, necessitated two further cultivations with the same implement prior to seeding the April plots.

The rainfall recorded on the farm during the year was as follows:—

Year.	Jan.	Feb.	Mar.	Apr.	Useful Rains.							Nov.	Total Jan.-Nov.
					May.	June.	July.	Aug.	Sept.	Oct.	Total		
1930	...	2	...	325	333	280	150	80	251	73	30	873	1,553
Wet days	...	1	...	11	6	9	10	7	15	4	5	50	72

It will be noticed that the season opened in a very promising manner, while there was a falling off in the rainfall towards the end of the growing period. During October and November the weather conditions were favourable for the development of rust and the variety Yandilla King was very badly attacked, causing a considerably decreased yield and resulting in pinched grain. Nabawa and Gluyas Early were also affected, but only very slightly.

The disease Takeall was prevalent in the Yandilla King and early sown Nabawa plots, while the later sown Nabawa and the Gluyas Early plots were very free of the disease. This confirms one of the methods advocated by the Department of Agriculture for the control of this disease, namely, that where paddocks are known to be infected with Takeall it is advisable to delay seeding until the early seeding rains have fallen, thus permitting a further cultivation which would assist to destroy the spores (or "seeds") of the disease, which have germinated. It must be remembered, however, that if seeding is delayed the variety planted must be of the correct maturity for the time that seeding takes place.

The results obtained are set out below:—

TIME OF SEEDING EXPERIMENT.

*Yandilla King—Late Variety.*

Seed—45lb. per acre.

Superphosphate—112lb. per acre.

Planted.	Computed Yields per Acre.				Average Yields per acre.	Average percentage Yields per acre.
	Section 1.		Section 2.			
	bus.	lb.	bus.	lb.	bus.	lb.
April 24th ... ..	10	8	.8	52	9	30
May 14th ... ..	7	22	7	52	7	37

*Nabawa—Midseason Variety*

Seed—45lb. per acre.

Superphosphate—112lb. per acre.

Planted.	Computed Yield per Acre.				Average Yields per acre.	Average Percentage Yields per acre.
	Section 1.		Section 2.			
	bus.	lb.	bus.	lb.	bus.	lb.
April 24 ... ..	21	22	19	26	20	24
May 14th ... ..	17	42	16	8	16	55
June 13th ... ..	9	44	9	30	9	37

*Gluyas Early—Early Variety.*

Seed—45lb. per acre.

Superphosphate—112lb. per acre.

Planted.	Computed Yields per Acre.				Average Yields per acre.	Average Percentage Yields per acre.
	Section 1.		Section 2.			
	bus.	lb.	bus.	lb.	bus.	lb.
May 14th ... ..	19	20	18	52	19	6
June 13th ... ..	12	6	10	48	11	27
July 13th ... ..	5	46	6	0	5	53

Although this experiment has been conducted for one year only, it confirms in no uncertain manner the results of the experiments and experience obtained at the Salmon Gums Experiment Farm. From these results the necessity for sowing the right variety, at its correct seeding period, and also the consequences of seeding too late, are apparent to all.

For the information of the Scaddan-Treslove settlers, the Departmental Seeding Calendar for this area is given below:—

Late Maturing Varieties, *e.g.*, Yandilla King, April 1st to April 21st.

Midseason Maturing Varieties, *e.g.*, Nabawa, April 21st to May 14th.

Early Maturing Varieties, *e.g.*, Gluyas Early, May 10th to May 31st.



## TIME OF SEEDING EXPERIMENT AT RAVENSTHORPE

G. L. THROSSELL, Dipl. Agric., Agricultural Adviser.

The object of this experiment was to determine the most suitable time to plant the wheat crop. After an inspection of the available fallow in the district, a site was selected on the property of Mr. F. E. Daw, situated about 3-4 miles east of Ravensthorpe on the Kuliba-Hopetoun road.

For the purpose of the experiment two varieties were used, namely, Nabawa, the standard mid-season variety, which was planted on April 11th, May 15th, and June 16th, and Gluyas Early, the standard early variety, planted on May 15th, June 16th, and July 17th. The plots, which were each a quarter of an acre in area, were duplicated.

The soil on which the experiment was planted was a sandy clay loam, originally carrying mallee. It was ploughed 4 inches deep with a mouldboard plough in July, 1929, springtyne cultivated in November, disc cultivated in March, and springtyne cultivated on 9th April. In addition, the May, June and July plots received a further cultivation prior to seeding.

The rainfall recorded at Ravensthorpe during the year was as follows:—

Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
				May.	June.	July.	Aug.	Sept.	Oct.	Total.			
...	7	340	173	377	103	149	135	76	55	955	42	15	1,538

The land was in splendid order as a result of the cultivation after the early rains. All plots germinated well, the dates of germination being as follows:—April plots, 20th April; May plots, 20th May; June plots, 21st June; and July plots on 26th July. A very heavy downpour of rain was experienced on 29th May which washed the surface of the May sown Gluyas Early plots, and one of the April sown Nabawa plots. Good rains were experienced during the winter months and the plots made splendid growth. However, the absence of late rains placed the late sown plots at a disadvantage, as would be expected.

The results obtained are shown in the following table:—

## TIME OF SEEDING EXPERIMENT.

*Nabawa—Midseason Variety.*

Seed—45lb. per acre.

Superphosphate—120lb. per acre.

Planted.	Computed Yields per Acre.				Average Yield per acre, 1930.	Average percentage Yield per acre, 1930.
	Section 1.		Section 2.			
	bus.	lb.	bus.	lb.	bus.	lb.
April 11th ... ..	26	36	25	16	25	56
May 15th ... ..	14	8	12	4	13	6
June 16th ... ..	9	48	8	32	9	10
						%
						198
						100
						70

*Gluyas Early—Early Variety.*

Seed—45lb. per acre.

Superphosphate—120lb. per acre.

Planted.	Computed Yields per Acre.				Average Yield per acre, 1930.		Average per-centage Yield per acre, 1930.
	Section 1.		Section 2.				
	bus.	lb.	bus.	lb.	bus.	lb.	%
May 15th ... ..	16	24	14	40	15	32	100
June 16th ... ..	10	40	9	24	10	2	65
July 17th ... ..	2	28	2	16	2	22	15

Although the early sown plots were interfered with by the heavy May rains, the results, which are for one year only, indicate how the yield is reduced by seeding after the end of May. While they emphasise the folly of seeding late, I would point out that it is unwise to go to the other extreme and plant too early. In order to assist the settlers in the Ravensthorpe area in this direction, the following seeding calendar is recommended:—

## SEEDING CALENDAR—RAVENSTHORPE DISTRICT.

*Dates of Planting.*

	North of Ravensthorpe.	Ravensthorpe and immediately South.	Kundip and Kuliba.
Late Maturing Varieties, <i>e.g.</i> , Yandilla King	Too late	April 1 to 15	April 15 to 21
Midseason Maturing Varieties, <i>e.g.</i> , Nabawa	April 15 to May 7	April 15 to May 7	April 21 to May 15
Early Maturing Varieties, <i>e.g.</i> , Gluyas Early	May 1 to 21	May 1 to 21	May 10 to 31
Very Early Maturing Varieties, <i>e.g.</i> , Noongaar	May 21 to 31	May 21 to 31	...

## TIME OF SEEDING EXPERIMENT AT NORTH BENCUBBIN.

T. LUTZ, B.Sc. (Agric.), Agricultural Adviser.

An experiment of this nature was conducted on the property of Messrs. Langley Bros., North Bencubbin, at the request of the Warkutting Progress Association.

For the purpose of the experiment, which was designed to demonstrate the necessity for timely seeding, two varieties were used, viz., Nabawa, the standard mid-season maturing variety, which was planted at monthly intervals April 16th, May 15th, and June 14th; and the standard early variety Gluyas Early, planted on May 15th, June 14th, and July 16th. The plots were each half acre in area and were duplicated.

The land on which the experiment was conducted originally carried salmon gum, gimlet, mallee and tea-tree. It was ploughed in July with a disc implement, springtyne cultivated in August and prior to seeding the plots. In addition, the May, June, and July plots received a further cultivation prior to seeding to control weed growth.

The rainfall recorded at North Bencubbin was as follows:—

Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
				May.	June.	July.	Aug.	Sept.	Oct.	Total.			
...	6	173	241	47	480	169	164	64	15	939	...	62	1,421

After experiencing a very dry month during May, when it was noted that germination was retarded, good winter rains were recorded. The season was a splendid one until September, when only light spring rains were recorded, affecting all plots adversely, but particularly the late sown ones.

The results obtained are as follow:—

# TIME OF SEEDING EXPERIMENT.

*Midseason Variety—Nabawa.*

Seed—45lb. per acre.

Superphosphate—75lb. per acre.

Planted.	Computed Yield per Acre.				Average Yields per acre.	Average Percentage Yields per acre.	
	Section 1.		Section 2.				
	bus.	lb.	bus.	lb.	bus.	lb.	%
April 16th ... ..	15	29	15	31	15	30	102
May 15th ... ..	15	18	15	0	15	9	100
June 14th ... ..	7	13	9	3	8	8	54

*Early Variety—Gluyas Early.*

Seed—45lb. per acre.

Superphosphate—75lb. per acre.

Planted.	Computed Yields per Acre.				Average Yields per acre.		Average percentage Yields per acre.
	Section 1.		Section 2.				
	bus.	lb.	bus.	lb.	bus.	lb.	%
May 15th ... ..	17	45	21	32	19	38	100
June 14th ... ..	12	2	15	14	13	38	69
July 16th ... ..	8	42	8	49	8	45	45

The results are for one year only, so that no definite conclusions can be arrived at. They agree, however, with similar experiments and show that May is the best month in which to plant the wheat crop.

## TIME OF SEEDING EXPERIMENT AT BENCUBBIN.

T. LUTZ, B.Sc. (Agric.), Agricultural Adviser.

Three experiments were planted on the property of Mr. B. W. G. Hopwood, Bencubbin, last season, viz., two Time of Seeding Experiments and a Wheat Variety Trial.

The land on which the experiments were planted originally carried mallee, jam, and teatree scrub.

The plots, which were planted on well prepared fallow, were duplicated and were each half an acre in area.

The rainfall recorded at Bencubbin during the year was as follows:—

Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
				May.	June.	July.	Aug.	Sept.	Oct.	Total.			
...	21	17	219	58	447	193	128	74	18	918	2	34	1,211

The early sown plots germinated well after the good April rains, but on account of the dry period experienced during May, the May sown plots did not germinate until June 3rd. The heavy winter rains and the mild season were ideal for the growing crops, and although good yields were obtained, the light spring rains adversely affected the yields.

For the purposes of the trial two varieties were used, namely, Nabawa, the standard mid-season maturing variety, and Gluyas Early, the standard early maturing variety. The varieties were planted at intervals of one month, viz., Nabawa, April 15th, May 15th, and June 15th; and Gluyas Early, May 15th and June 15th. The July plots with this variety could not be planted on account of the boggy condition of the ground.

The results obtained are as hereunder:—

*Midseason Variety—Nabawa.*

Seed—45lbs. per acre.

Superphosphate—112lbs. per acre.

Planted.	Computed Yields per Acre.		Average Yields per acre.	Percentage Yields per acre.
	Section 1.	Section 2.		
	bush. lbs.	bush. lbs.	bush. lbs.	per cent.
April 15th ... ..	17 4	17 16	17 10	81
May 15th ... ..	29 6	22 28	21 17	100
June 15th ... ..	16 42	17 0	16 51	79

*Early Variety—Gluyas Early.*

Seed—45lbs. per acre.

Superphosphate—112lbs. per acre.

Planted.	Computed Yields per Acre.		Average Yields per acre.	Percentage Yields per acre.
	Section 1.	Section 2.		
	bus. lb.	bus. lb.	bus. lb.	%
May 15th ... ..	22 26	21 52	22 9	100
June 15th ... ..	19 10	18 12	18 41	84

As this experiment has been conducted for one year only, no definite conclusion can be arrived at. However, the results indicate that May is the best month in which to plant the crop.

The following seeding calendar is recommended for this area:—

#### SEEDING CALENDAR.

##### BENCUBBIN DISTRICT.

Variety.	Time to Plant.
Late Maturing Varieties, <i>e.g.</i> , Yandilla King ...	Too late for District.
Midseason Maturing Varieties, <i>e.g.</i> , Nabawa ...	April 15th to May 7th.
Early Maturing Varieties, <i>e.g.</i> , Gluyas Early ...	May 1st to May 31st
Very Early Maturing Varieties, <i>e.g.</i> , Noongaar ...	May 21st to May 31st

#### WHEAT VARIETY TRIAL.

In addition to a Time of Seeding Trial, a Wheat Variety Trial was conducted with the mid-season varieties Nabawa and Bencubbin, and the early variety Gluyas Early as control.

The results are shown in the following table:—

Planted 13th May.      Seed—45lb. per acre.      Superphosphate—112lb. per acre.

Variety.			Computed Yields per Acre.				Average Yields per acre.	Average percentage Yields per acre.	
			Section 1.		Section 2.				
			bus.	lb.	bus.	lb.	bus.	lb.	%
Gluyas Early	...	...	20	18	19	5	20	5	100
Bencubbin	...	...	26	2	25	24	25	43	128
Nabawa	...	...	22	4	18	34	20	19	105
Gluyas Early	...	...	19	52	18	52	19	22	100

Good yields were obtained from all varieties, but as the trial has been conducted for one year only, no conclusions can be arrived at. The variety Bencubbin, however, shows to advantage.

## FEEDING WHEAT TO PIGS.

G. K. BARON-HAY,  
Superintendent of Dairying.

Enquiries are being received daily as to the profit likely to be derived from the feeding of wheat to pigs, and whether, with wheat alone available as a food, it is possible to rear pigs suitable for the bacon trade.

A visit to the metropolitan market at Midland Junction will convince the observer that many excellent bacon pigs are now being forwarded from wheat-growing areas, but it also will be obvious that large numbers are being incorrectly fed, with disappointing results to the owner when sold.

It is hoped that the following notes will be of value to those intending to market a portion of their crop of wheat in the form of pork or bacon.

### MAKING A START.

While undoubtedly more profit is made from feeding pigs bred on the farm, this will be impossible in the initial stages, owing to the delay necessary for breeding and weaning the prospective bacon pigs.

A start will have to be made with store pigs, probably bought in the market.

The chief drawback to purchasing store pigs is the difficulty of obtaining a sufficient number of the right type and of even weights.

A long bodied pig, with long deep middle, heavy ham and a light shoulder is the type to purchase, and should be relatively lean, otherwise there may be a danger of fattening when too small.

The size of pig to buy for fattening will depend to a great extent on the cost of freight and cartage to and from market. The greater these costs the younger should store pigs be purchased, and fed to as heavy a weight as practicable, in order to spread this cost over as many bushels of feed wheat as possible.

There is a limit, however, to the weight at which young pigs may be purchased for feeding with wheat. Experience has shown that weaners cannot be purchased safely and reared on wheat as a basal ration. It is inadvisable to purchase pigs weighing less than 80 lbs. (live weight) for fattening purposes.

### BREEDING.

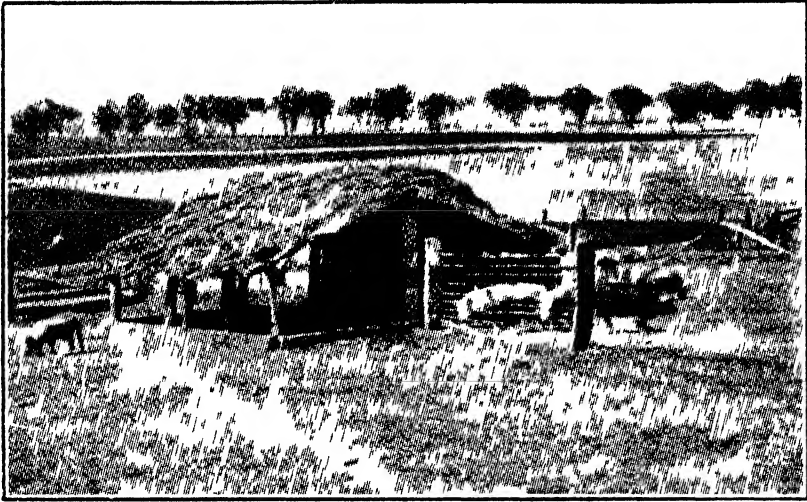
The aim should be to breed one's own baconers as soon as possible. For this purpose good high grade sows of the Berkshire breed, or Berkshire-Tamworth cross may be bought at almost any large pig sale to-day. These should show good length and depth, fine skin free from wrinkles. They should be fine in bone and have at least 12 well placed teats.

It is essential to obtain, from a reputable breeder, a pedigreed boar for mating with these sows, and if possible from a large litter. This boar should show all the essential points of a bacon pig. See article in "Journal of Agriculture," March, 1930—"The Bacon Pig," Bulletin 296.

The pure bred Berkshire boar is recommended for general "grading-up" purposes.

### SHELTER AND WATER SUPPLY.

On Wheat Belt areas it is essential that ample shade should be provided. Cheap temporary shelters may be made from saplings, the roof being of straw or boughs and approximately 4 feet from the ground. These may be burned without serious loss, should they for any reason become foul.



A cheap effective shelter on a wheat farm

A plentiful supply of clean water is also essential. The writer has in mind where a farmer lost several valuable sows through allowing them to drink water from a clay hole, the clay flocculating in the intestines, causing impaction. Water should be available from troughs only.

### FEEDING WHEAT

Wheat alone is not a complete ration for growing pigs, being low in proteins for flesh building, and also lacking in mineral matter for skeleton formation. This deficiency may be made up in two ways —

- (1) By the addition of skim milk to the ration
- (2) By the addition of meatmeal and bonemeal

*Skim Milk* — A large quantity of skim milk is not necessary to provide the protein required to form a complete ration. One gallon to each 4 lbs. of grain feed is sufficient, and also economises in grain.

Skim milk, if available, should be reserved for weaner pigs.

*Meatmeal and Bonemeal* — Where skim milk is not obtainable, meatmeal must be fed in the proportion of approximately 8 per cent of the grain ration. In addition, bonemeal should form 2 per cent of the ration.

### WHOLE OR CRUSHED WHEAT

Wheat should be crushed or cracked before being fed, and provided this is carried out, there is no need to soak the wheat.

Uncrushed wheat, however, shows a loss as high as 20 per cent over crushed wheat, through not being digested.

The cost of feeding can be considerably reduced by using self-feeders, allowing the pigs to have free access to both wheat and meatmeal. It has been found in numerous feeding tests that self-feeders are economical in feeding, and that the pigs consume meatmeal at approximately 8 per cent. of the total grain consumption.

#### COST OF FEED CONSUMED.

The results of fifteen months' feeding on the Rutherglen Experiment Farm, Victoria, concluded last November, have shown that, on the rations mentioned above, allowing the pigs to consume all they desire.

The average grain per pig per day = 1.35 lbs.

Feed per pig per day = 3.47 lbs. wheat and .28 lbs. meatmeal.

Feed per lb. gain in weight = 2.57 lbs. wheat and .20 lbs. meatmeal.



Pigs Pasturing.

The following table will indicate on these figures that the feeding of wheat to pigs, even at present prices of bacon, is profitable:

Pig purchased at 80 lbs., and fattened to 180 lbs. live weight.

	£	s.	d.
Purchase price 80 lb. pig (live weight) ..	1	5	0
Meatmeal consumed, 20 lbs. at 1.87d. ..	0	3	11½
Bonemeal, 4 lbs. .. .. .	0	1	0
	1	9	11½
Present day value .. .. .	2	10	0
Value of wheat fed .. .. .	£1	0	10½
or 3s. 7d. per bushel.			

The nett return will vary depending on the location of the farm from the market, but costs can be accurately worked out for any locality, using the above figures for food consumed.



## JUNIOR FIELD TRIALS WITH WHEAT.

MERREDIN EXPERIMENT FARM, 1930.

E. J. LIMBOURN,  
Cereal Breeder.

These trials were planted on 19th May in a plot adjoining the Test Rows, the method of planting being similar to previous years.

Each variety was sown down two tubes of the drill, a drill width containing five varieties with the control variety Gluyas Early on either side.

The length of the plots, as planted, was 10 chains, which was later subdivided into 10 sections of 87 links with a division of four links between each section, the balance of the plot forming a headland.

Three of these sections were harvested as hay, six for grain, and one was left standing so that information regarding the strength of straw and ability of the different varieties to hold their grain could be obtained.

Germination was somewhat delayed by dry conditions at the time, there being practically no rain from 9th May until 1st June. This dry spell following good rains during April had enabled the plot to be well cleaned from weeds, and, except for lack of moisture, the soil was in splendid condition for planting. Very little malting of the seed occurred, and a good germination was obtained after the early June rains.

The trial consisted of eight new crossbred wheats with Gluyas Early as the control variety, Nabawa and Carrabin being also included for comparison.

Weather conditions were ideal for growth, the plants stooling out rather than running up to straw, although the general height of straw was above the average. Ears were all well formed and mostly filled three grains to the spikelet, grain being fairly plump and of a good colour.

The crossbred varieties of strong milling qualities gave disappointing yields compared with Gluyas Early or Nabawa, the higher yields being obtained with the more starchy-grained types.

One or two of the strong milling crossbreds continue to give rather better yields than Carrabin, and for that reason a milling test with these crossbreds should be of interest. In the 1929 milling test (Nabawa x Carrabin) M. 26 showed a decided improvement over Nabawa, although not equal in strength of flour to Carrabin.

Except for a few patches of Take-all, mainly in Section A, the planting was very free from disease.

Flag Smut was found throughout the Gluyas Early controls, the loss from this disease being possibly one per cent. All other varieties were entirely free from infection by this disease, which goes to show that the method of selecting new varieties for resistance to this disease is quite satisfactory. No definite sign of resistance to Take-all could be noticed, the diseases being fairly general throughout the experiment, all varieties being affected.

Rust appeared in a mild form during October, all varieties being attacked, but no apparent effect on yield or quality of the grain could be noticed.

Special note was made of the standing quality of the straw, a portion of the planting being left standing until towards the end of December. Gluyas Early lodged rather badly in places, and the selection from Minflor—P. 1753—broke down after heavy rain in December, but stood fairly well up to that time. (Nabawa x Bunyip, M. 14, also broke down somewhat, the straw being very brittle. The other varieties were all decidedly better than Gluyas Early, odd straws breaking down only.

## JUNIOR FIELD TRIALS—WHEAT—GRAIN YIELDS, 1930.

Variety.	Reg. No.	Average height.	Sec. A.	Sec. B.	Sec. C.	Sec. D.	Sec. E.	Total Yield.	Average Yield per section.	Comparative percentage Yield.
		inches.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	%
Gluyas Early ... ..	P 159	46	94-125	95-750	87-250	91-125	84-125	452-375	90-475	100
(D.A.C. 4179 x Nabawa)	C 84	46	99-750	82-750	76-625	83-000	83-250	395-375	79-075	86
(Federation x Carrabin)	M 37	45	71-250	76-250	61-625	64-125	58-250	331-500	66-300	72
Nabawa ... ..	P 1432	44	79-250	74-000	82-000	79-250	77-500	392-000	78-400	85
Nabawa x Carrabin)	M 24	45	59-250	62-750	69-000	69-000	72-750	312-750	62-550	68
Nabawa x Carrabin)	M 35	48	66-125	58-125	67-000	68-750	65-625	315-625	63-125	69
Gluyas Early ... ..	P 159	47	91-750	89-000	100-750	95-500	92-725	469-750	93-950	100
Gluyas Early ... ..	P 159	47	81-125	91-000	101-625	93-500	98-375	468-625	93-725	100
Minflor—Selection from	P 1753	42	57-250	62-750	69-250	63-500	67-500	319-750	63-950	70
Florence x Carrabin)	M 24	47	43-500	45-375	50-875	51-000	57-250	248-000	49-600	55
Carrabin ... ..	P 1437	47	38-875	63-000	69-250	63-375	42-000	276-500	55-300	61
Nabawa x (Gluyas Early)	M 20	47	112-125	113-000	112-625	111-250	109-375	558-375	111-675	112
(Nabawa x Bunyip)	M 14	47	63-500	83-750	100-500	77-875	90-500	416-125	83-225	91
Gluyas Early ... ..	P 159	47	79-375	93-375	91-750	88-875	89-250	442-625	88-525	100

## JUNIOR FIELD TRIAL—WHEAT, 1930—SUMMARY OF RESULTS.

Variety.	Reg. No.	Season of Maturity.	Average Height.	Comparative percentage Yield.
			inches.	%
(Nabawa x Gluyas Early)	M 20	Early	47	112
Gluyas Early	P 159	Early	47	100
(Nabawa x Bunyip)	M 14	Very Early	47	91
(D.A.C. 4179 x Nabawa)	C 84	Midseason	46	86
Nabawa	P 1432	Midseason	44	85
(Federation x Carrabin)	M 37	Early	45	72
A selection from "Minflor"	P 1753	Very Early	42	70
(Nabawa x Carrabin)	M 35	Early	48	69
(Nabawa x Carrabin)	M 26	Midseason	45	68
Carrabin	P 1437	Early	47	61
Florence x Carrabin	M 24	Early	47	55

The Yield of "Gluyas Early" as shown above, is computed from the average yield of all four control plots.

## COMPARATIVE PERCENTAGE RESULTS IN PREVIOUS SEASONS—GLUYAS EARLY = 100 %

Variety.	Reg. No.	Comparative percentage yields.				Average.
		1927.	1928.	1929.	1930.	
		%	%	%	%	%
Carrabin	P 1437	...	83	77	61	74
Nabawa	P 1432	...	97	94	85	92
(Nabawa x Gluyas Early)	M 20	...	122	107	112	114
(Nabawa x Bunyip)	M 14	79	86	91	91	87
(D.A.C. 4179 x Nabawa)	C 84	...	...	97	86	91
(Nabawa x Carrabin)	M 35	...	...	94	69	81
(Nabawa x Carrabin)	M 26	...	93	87	68	83
Florence x Carrabin	M 24	83	84	...	55	74

The rainfall for the year was as follows, the averages being for the past 19 years, from 1912-1930.

	Jan.	Feb.	Mar.	Useful Rains.							Nov.	Dec.	Total for year.	
				Apl.	May.	June.	July.	Aug.	Sept.	Oct.				Total.
1930 . . .	...	1	231	186	40	363	137	184	65	34	1,009	1	41	1,333
Average 1912/31 . .	55	56	125	70	130	195	188	140	93	75	821	41	54	1,234

### NOTES ON THE NEW VARIETIES.

(*Nabawa x Bunyip*), M. 14.—Owing to the brittle nature of the straw and its general similarity to the parent type, Bunyip, it has been decided to discard this crossbred. It shows no definite improvement over Bunyip, and did not yield nearly as well as the variety Noongaar in the Seasonal Variety Field Trials.

(*Nabawa x Gluyas Early*) M. 20.—An early variety, resistant to Flag Smut, that is giving consistently higher yields than Gluyas Early. In the May planting of the Seasonal Variety Trial it gave an average increase of yield over Gluyas Early of three per cent. over the five plots harvested. It has a semi-solid straw like Gluyas Early, but being stouter and less whip-like, it has not the same tendency to lodge. Its resistance to Flag Smut should make it a valuable variety to combat the extension of that disease which is increasing rapidly in this State, and which in the Eastern States is considered one of the worst diseases that affect wheat crops.

(*Florence x Carrabin*) M. 24.—Although of strong milling quality and resistant to Flag Smut, its low yield does not warrant a further trial.

(*Nabawa x Carrabin*) M. 26.—This is a strong milling variety, resistant to Flag Smut, giving a rather better yield than Carrabin.

(*Nabawa x Carrabin*) M. 35.—A selection from the same cross as M. 26. Resistance to Flag Smut, and of strong milling quality. It makes taller growth, and matures earlier than M. 26, and for the two years under test has given a slightly increased yield.

(*Federation x Carrabin*) M. 37.—This is a doubtful variety at present, being rather irregular in growth and very tough to thresh. It gave the best yield of the strong milling varieties, and may improve under selection. It is also resistant to Flag Smut.

A Selection from "*Minflor*," P. 1753.—This is an early maturing strain selected from the variety "*Minflor*," received from Mr. H. Pye of the Dookie Agricultural College, Victoria. Being short in the straw it was thought that it would prove useful to overcome damage by strong winds. The straw, however, is very brittle, and broke down rather badly. There is a late maturing strain of this variety that has the same brittle straw. Both strains are very resistant to both Flag Smut and Bunt, but show possible susceptibility to Rust.

(*D.A.C. 4179 x Nabawa*) C. 84.—It is doubtful whether this is any improvement over "*Nabawa*."

## LUCERNE FOR THE SOUTH-WEST.

M. CULLITY, B.Sc.(Agr.),

Agricultural Adviser.

Lucerne is one of our oldest cultivated crops, having been used by man for more than 2,000 years. It belongs to that family of plants known as the *Leguminosae*, various members of which have been largely used by farmers in the past century in their rotations, they having observed that crops following on legumes seemed to grow much better. They believed this result was due to some peculiarity of legumes, but it was not until the last thirty years that this peculiarity was explained. The association with certain bacteria in the soil enables legumes to draw one of the principal plant foods, not from the soil, but from the air. The plant and bacteria exist together for their mutual benefit in a state of symbiosis, the bacteria living on plant juices or substances drawn from those juices, while at the same time making available to the plant stores of easily assimilable nitrogen which has been drawn from the air, where it exists in enormous quantities in a form useless to the plant. The indication of the presence of these bacteria may be easily seen by examining the root system of a species of this family of plants for small growths known as nodules.

Lucerne, however, does not often figure in an ordinary rotation, so the beneficial effects to crops following it are not often seen. What is more often apparent, however, is the comparatively poor growth of lucerne due to an insufficient number of the lucerne bacteria being present. This can be remedied by the farmer by topdressing the area with a small quantity of soil taken from an area where lucerne is growing strongly. However, it is always better to take the precaution to see that bacteria are present when sowing. This may be done in three different ways—

- (1) by topdressing the area to be sown with a quantity of soil as above; or
- (2) by mixing the seed to be sown with a few pounds of soil as above, dried, but not heated. (The drying of this soil should be done in a shaded place, as sunlight will kill the organisms. Sowing should then be carried out in the afternoon to prevent the injurious action of the sun);  
or
- (3) pure cultures of the organism may be obtained from the Plant Pathology Branch of the Department of Agriculture at a small charge to cover postage. These are shaken up in skim milk or very thin glue, and the seed mixed with it. It is dried sufficiently for sowing, which, as with the soil dusting method, should be carried out in the afternoon.

### SOILS.

Lucerne thrives in a variety of soils, and, from the experience in the newer districts in the South-West, it would appear that with attention, payable results may be obtained off almost any soil. The best condition is a deep free-working soil, with free water several feet below ground level, but in the majority of cases where a good permeable subsoil is present, enabling the long roots to penetrate, it will be found that lucerne will thrive. Even in cases where on examination of the subsoil it would appear to be too stiff for roots to penetrate, payable results have been obtained.

One absolute essential to success is drainage, as lucerne will not grow in sour soil. Patches are often seen in lucerne plots where weeds, etc., are prolific, and

the lucerne appears to have died out. These on examination usually are depressions where water lies. The benefit of lime to lucerne is often attributed to its sweetening effect rather than any mechanical or manuring effect.

### PREPARATION OF SOIL.

Lucerne being a deep rooter, it is necessary that the preparation of the soil be to such a depth as to allow the young roots to get as far down as possible in a short time. The depth of ploughing, however, must be controlled by the type of soil. If the soil is only four inches, it would be a mistake to plough six inches and bring a portion of the subsoil to the surface. Weeds are a big problem in establishing a new field, as these will often kill or choke out the young lucerne plants which are slow growers. It is preferable to plough the land some time before it is required to sow, and to destroy the weed growth by frequent cultivation. Where autumn planting is carried out this cannot be done as the germination of the weeds and the lucerne will take place about the same time. To control this it is necessary to plant the lucerne in drills so that cultivation may be given between the rows. Where possible it is preferable to sow the ground that is to be laid down to lucerne with some clearing crop, oats, etc., but preferably potatoes where it can be done. This crop has the advantage of opening up the soil to a good depth, leaving a large residue of fertilizer behind, and leaving the ground free from weeds.

The land should be worked down to a good seed bed, with the disc cultivator or harrows. Often before sowing, a final very shallow ploughing is given, followed by the harrows and the roller to give a fine, firm seed bed. The rolling is necessary, because the lucerne seed being small requires to be well packed in the soil, otherwise malting may occur.

Time of sowing will vary with the conditions. With good moisture holding soils spring planting is better, as this gives an opportunity of cultivating for weed destruction throughout the autumn and winter. On other locations, however, as on the hillside slopes of Manjimup, for instance, it is often advisable to sow in the early autumn in drills. The lucerne will germinate and make fair growth before the winter sets in. The plants then generally are in an excellent condition for fast growth during the ensuing spring, for as the moisture recedes in the soil the young tap roots are in a position to be able to follow it down.

On the flats or in the gullies of that district sowing may be held over until the spring, providing the area is worked up early in the autumn, and has been kept clean.

### SOWING

The quantity of seed to sow will vary according to whether the crop is sown in drills or broadcast. Where drilled six to eight lbs. seed will be found sufficient. Where broadcast 12 to 15 lbs. will be required to give a good result. Both methods have their advocates and good results may be obtained by either method.

Where weed growth is bad or summer cultivation is necessary, it will be found that sowing in drills will enable weed control and moisture conservation to be carried out much more easily. However, where the ground is clean and sufficient summer moisture is not a problem, broadcasting is the easier method.

### MANURING

When sowing, a mixed manure of superphosphate and sulphate of ammonia is desirable. The sulphate of ammonia is included, as the young plants will not have sufficient bacteria on their roots to absorb enough nitrogen from the air. A mixture recommended is not less than 224 lbs. superphosphate and 56 lbs. sulphate of ammonia per acre.

As the yields of lucerne when properly established are huge, it is necessary that continuous manuring be resorted to. Not less than  $1\frac{1}{2}$  cwt. of superphosphate should be applied twice in each year—first in early autumn and the second in early spring. The reason for this manuring is that each cutting of lucerne may be considered as a separate crop, and when five or six cuttings are made in one year, the necessity for manuring heavier than for the ordinary cereal or pea crop is obvious.

It is particularly beneficial—where the soil selected is suspected to sourness—to apply a dressing of slaked lime at the rate of approximately one ton per acre (half ton quicklime). Where freight charges are high it is preferable to purchase this as quicklime, allowing the lime to air slake before applying. Where liming is to be carried out, it is necessary to arrange the work so that this may be done at least a month before the seed and fertiliser are applied.

#### AFTER CULTIVATION.

Following on the germination of the lucerne, the farmer's heart is often saddened by a dense growth of weeds, and as the young lucerne plants are not strong enough to withstand cultivation, he is often at a loss to know what to do. The remedy is easy, it being only necessary to keep the whole growth low by mowing or grazing. Where the mower is available it should be used when the plants are just about six inches high. As this cut is not worth gathering, it is left as a mulch over the surface. Often, however, it is decided that the cheapest and easiest method is to graze the field. This for best results should be done as quickly as possible, and with small stock. Where the field is kept low the weeds are losing in vitality during the whole period while the lucerne roots are getting a stronger and firmer hold, giving the plants an added vitality and enabling them to shoot away from the weeds. The grazing or mowing has an added benefit in causing the lucerne crowns to throw out more stems, or, in other words, to stool out.

As soon as the plants are considered strong enough, which may be decided by pulling at the roots, cultivation should be resorted to. The area should be grazed or mown, and the harrows or cultivator then brought in. Where sown in drills the scuffler may, of course, be used without cutting the crop. As a general rule, it should be remembered that the more cultivation given, the better the yields, one effect of stirring the soil being to allow the air in greater quantities into the ground where the nitrogen may be withdrawn by the nodular bacteria. A good routine for working is to decide on two main cultivations in each year—one in early autumn when the first rains are expected, and the other in early spring or when the winter rains are finishing. Topdressing should be applied at these times. After each cutting a good harrowing is particularly beneficial. These cultivations have a twofold benefit—in the cold weather in allowing more free access of air to the nitrifying bacteria, and in the spring and summer in making a mulch, conserving the moisture necessary for the summer growths.

#### HARVESTING OR TIME FOR CUTTING FOR HAY.

Two main indications are to be looked for when deciding when the lucerne crop is ready to be cut for hay.

- (1) When the plants begin to flower.
- (2) When the crowns begin to throw out new shoots.
- (3) In some cases, in cool weather, loss in feeding value and weight occurs before the plants flower; the indication that this is happening is given by the lower leaves turning colour. Good hay should be green, fresh, free from weeds and rubbish, with a good pleasant aroma, and carrying all the leaves.

If hay-cutting is delayed beyond any of the three stages mentioned above, loss will occur by a loss in digestibility. Leaves will drop off more easily in handling, making for a loss of weight. A further consequence to the delay in cutting is that the succeeding growth will not come away as quickly nor will it yield as well.

The best season for hay-making is during the late spring or summer, as the weather is then suitable for curing. Earlier in the season it will usually be found more profitable to feed green or to graze, as the sappiness of the stalks and the unsettled state of the weather makes the task of hay-making a hazard.

Lucerne "cures" very quickly, so the skill in handling it needs to be higher than that required for ordinary meadow hay. Care should be taken that the drying material is not handled more than strictly necessary during the heat of the day. Raking into windrows and carting to the stack is best done in the morning or late in the afternoon. During the middle of the day the material dries out and becomes extremely brittle, resulting in nearly all the leaf being lost if harshly handled then. In the afternoon when the atmosphere is cooling, moisture is absorbed by the hay, with the result that it can be handled with comparative ease.

It is advisable that the windrows be formed as soon as possible after cutting, allowing the green material time to wilt only. In our climate, as often as not, the hay can be stacked direct from the windrow, but where stacking has to be delayed, it is advisable to form it into large cocks as soon as the plants are dry enough. This may be tested by examining a sample. If, when twisted with the hands, no sap is discernable, it may be concluded that the material is in condition for stacking or placing in large cocks. Care, also, should be exercised that the plants do not get too dry or brittle in the rows.

#### YIELDS.

Five cuttings in one year is about the minimum that may be expected from this crop. Each cutting should yield at least  $1\frac{1}{2}$  tons of hay, so that the minimum quantity of hay that a plot would yield, if not fed green or grazed, would be approximately seven tons per acre. Mr. G. F. Combs, of Jardee, between September, 1928, and April, 1929, obtained seven cuttings from his two acres, and, while feeding it green and as hay to his herd of cows during the whole period, finished up with approximately seven tons stacked in his shed.

#### LIFE OF A STAND.

The length of time during which this crop will produce these quantities of fodder should make every farmer a lucerne grower. Small plots in the Manjimup-Pemberton area have been in existence from the early days of group settlement, some of the outstanding successes being those of—J. Prosser, 10 acres; D. Hunter, 6 acres; A. V. Kjellgren, 3 acres.

One paddock in the Denmark area has now been down to lucerne for 20 years. Naturally, after a period of years, the stand becomes a little thinner, and it is sometimes then advisable to plough in for a change of crop for a year or two, and then to reseed.

#### GRAZING.

Where it is intended to graze an area of lucerne great discrimination must be shown, or else considerable damage will be done to the crop. When it is young the roots have not firm enough hold of the ground to withstand the severe tugging and pulling that it would receive from large stock, therefore, while the stand is still young it is advisable to graze only with small stock, and then by putting as many on as possible so as to shorten the time of grazing, and by taking them off

before grazing bare has occurred. Where possible, it is advisable to avoid grazing during the first two years. With sheep it is particularly necessary to exercise care in this respect, as these stock can graze very close to the ground, and as a consequence, if left in the paddock too long, will crop off the crowns of the plants, resulting in the following crops being considerably thinner.

Continuous grazing of lucerne has a particularly bad effect on the crop, and to avoid this, when it is fit for grazing by ordinary stock, it is advisable to put as many on at a time as is possible. This ensures that the whole crop will be eaten off even before the young shoots commence to appear on any portion.

Care should be taken when grazing stock on lucerne that they are not let in when it is wet, either by rain or dew, or when they are very hungry. Hoven is likely to be caused by feeding this succulent feed to hungry stock. The danger is greatly increased when the plants are wet. When cattle are being introduced to this crop after a spell away from it, it is much better that they be well fed first so that they will not be able to consume great quantities, or, if this is not possible, to turn them on for thirty minutes and take them off, letting them on again for a similar period a few hours later. They soon become accustomed to the crop, and will be able to remain in the crop without danger. However, it must be said that grazing, whatever its advantages, materially lessens the life of a stand.

It is difficult to understand why farmers, and particularly dairy farmers, in the South-Western districts do not pay more attention to this crop. As a general statement, it may be said that suitable lucerne soil exists on every location. In the group settlement areas a very large number of farmers have small areas, but have room for increase. In Bridgetown, Balingup, Kirup, Donnybrook, etc., practically none is grown although great benefits would follow its introduction, particularly where the farmer has to milk his cows during the dry months. The provision of green lucerne then will make all the difference in the yield of his stock.

## LUPIN INOCULATION.

E. J. LIMBOURN,

Cereal Breeder, Merredin Experiment Farm.

Two methods of soil inoculation with lupins were successfully tried. In the grass garden, where the seed is planted by hand, soil from the Chapman Farm and in which lupins had previously been grown during the past season was sprinkled in the rows before planting the seed. No nodule formations had appeared on the lupins when planted in the grass garden in previous seasons, but the roots were well encrusted with them after the inoculation. The plants also made better growth and seeded more prolifically, but this may have been due to the seasonal conditions.

For planting by drill the lupin seed was first dipped into a syrup made by melting sugar, and then rolled in the soil obtained from the Chapman Farm. It was found necessary to go through the seed afterwards and break up any lumps formed where two or three seeds had stuck together, but sufficient soil adhered to the seed, and it could be planted with the drill without any trouble. The planting had to be made very thinly, as the amount of seed available was very limited. The inoculation, however, was successful, as was shown by the nodule formations found on the roots. This method will be tried again this coming season in another paddock.



			December.				January.				February.			
			3rd.	10th.	17th.	30th.	7th.	14th.	21st.	28th.	4th.	11th.	18th.	25th.
			d.	d	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
Mutton	...	...	3	3½	3½	3½	3	2½	2½	3	3½	3½	2½	2½
Beef	...	...	4½	5½	5½	5½	6	6	5½	5½	5½	6	5½	6
Pork	...	...	6½	6½	6½	7½	7	7	6	6	6	6	6	6
Bacon	...	...	5½	5½	5½	5½	5½	5½	5½	5½	5½	5½	5½	5½

## MARKET REPORT.

Messrs. H. J. Wigmore & Co., Ltd., of Wellington Street, Perth, have supplied us with the following information regarding Chaff offered at auction in the Perth Railway Yards for the period December to February (inclusive). In all cases the price quoted is for f.a.q. to prime Wheaten Chaff, packed in new bags:—

	Quantity.	Maximum per ton.			Minimum per ton.		
		£	s.	d.	£	s.	d.
December, 1930 ..	1,025 tons	3	15	0	3	5	0
January, 1931 ..	950 tons	3	15	0	3	10	0
February, 1931 ..	845 tons	3	15	0	3	10	0

The period under review has been very disappointing from a grower's standpoint, qualities under f.a.q. to prime have been very difficult to quit at low prices. During the months of December, January, and February, there has been very little alteration in the price of f.a.q. to prime Wheaten Chaff. At the time of going to Press the market value for f.a.q. to prime at auction is from £3 12s. 6d. to £3 15s., f.a.q. from £3 5s. to £3 7s. 6d., mediums from £2 12s. 6d. to £2 15s. per ton.

*Oaten Chaff.*—During the past three months the market has been well supplied, and low prices have been ruling. During December prime green quality was realising from £3 5s. to £3 7s. 6d., f.a.q. from £3 2s. 6d. to £3 5s., mediums from £2 12s. 6d. to £2 15s. per ton. In January good supplies were coming forward to a dull demand, and f.a.q. found buyers at from £2 15s. to £3, mediums from £2 10s. to £2 12s. 6d. per ton. During February several trucks of prime green Oaten realised from £3 2s. 6d. to £3 5s., f.a.q. sold at from £2 15s. to £3, mediums at £2 12s. 6d. per ton.

*Oats.*—Throughout the period under review there has been little or no alteration in the market value of Oats. The closing quotations are as under:—

### December—

Good heavy feed Guyras, Mulgas and Algerians ..	1 5 to 1 6	per bushel.
Good feed .. .. .	1 3 to 1 4½	„
Light feed .. .. .	1 0 to 1 2	„

### January—

Good heavy feed Guyras, Mulgas and Algerians ..	1 5 to 1 7	„
Good feed .. .. .	1 3 to 1 5	„
Light feed .. .. .	1 0 to 1 2	„

### February—

Good heavy feed Guyras, Mulgas and Algerians ..	1 5 to 1 6	„
Good feed .. .. .	1 3 to 1 4	„
Light feed .. .. .	1 0 to 1 2	„

*Wheat.*—During December f.a.q. was selling at from 2s. 5d. to 2s. 8d., second grade from 2s. 2d. to 2s. 3d., smutty samples from 1s. 9d. to 2s. per bushel. At the beginning of January heavy supplies were coming forward and the market eased somewhat. F.a.q. was selling at from 2s. 2d. to 2s. 3d., second grade from 1s. 10d. to 1s. 11d., smutty and inferior from 1s. 7d. to 1s. 9d. per bushel, but towards the latter end of the month the market firmed to 2s. 6d. per bushel. In February heavy supplies were coming forward to a dull demand, and f.a.q. sold down as low as 2s. 1d. to 2s. 1½d. per bushel. Towards the end of the month very few consignments came forward on account of the low prices ruling, and the market advanced from 2s. 6d. to 2s. 7d., second grade realised from 2s. to 2s. 3d., smutty and inferior from 1s. 9d. to 1s. 10d. per bushel.

## METEOROLOGICAL INFORMATION.

STATIONS.	TEMPERATURE.			RAINFALL.	
	Maximum.	Minimum.	For Month.	Aver. age.	For Month.
DECEMBER, 1930.					
Chapman State Farm	87.0	105.2	50.7	52.3	0.04
Geraldton	80.0	107.0	43.1	52.0	0.09
Woolaving	84.1	105.0	57.9	48.2	1.04
Perrin	79.7	101.0	60.5	48.8	0.90
Kalamunda	80.5	98.3	56.8	48.6	1.68
Bunbury	75.9	91.5	56.2	44.0	0.35
Bridgeport	82.7	104.2	49.4	36.0	0.23
Albany	73.0	97.0	55.5	46.0	2.07
Merredin State Farm	83.5	102.4	59.1	43.0	0.41
Northam	88.5	103.8	59.3	46.8	0.37
York	87.3	105.0	58.2	45.2	0.07
Narrogin State Farm	84.0	102.7	54.0	44.4	1.12
Kalamang	82.2	103.0	54.4	43.4	1.18
Cape Leeuwin	70.8	85.5	59.5	53.0	1.05
JANUARY, 1931.					
Chapman State Farm	94.4	106.2	65.3	53.5	0.00
Geraldton	88.1	106.2	66.3	56.4	0.00
Woolaving	93.4	106.0	62.3	48.6	0.00
Perrin	86.0	104.3	63.1	51.0	0.03
Kalamunda	87.3	102.2	60.4	42.2	0.00
Bunbury	81.4	94.0	58.2	44.0	0.00
Bridgeport	91.4	106.0	50.8	38.0	0.06
Albany	75.3	102.3	58.7	51.0	0.24
Merredin State Farm	92.1	104.2	61.9	46.8	0.00
Northam	93.7	105.0	61.5	48.0	0.00
York	92.8	105.0	59.4	45.5	0.00
Narrogin State Farm	91.7	102.7	54.5	39.8	0.00
Kalamang	88.9	101.7	57.1	45.7	0.00
Cape Leeuwin	75.4	99.0	61.2	54.0	0.15
FEBRUARY, 1931.					
Chapman State Farm	90.1	107.0	61.2	53.5	0.00
Geraldton	82.3	104.8	63.2	51.6	0.00
Woolaving	89.4	106.8	59.5	52.3	0.02
Perrin	81.7	102.0	60.1	51.8	0.04
Kalamunda	82.3	102.0	57.5	49.1	0.03
Bunbury	76.4	90.0	55.4	46.0	0.12
Bridgeport	101.2	107.0	47.6	37.0	0.30
Albany	84.3	97.7	58.7	52.0	0.36
Merredin State Farm	91.0	108.0	57.8	49.0	0.54
Northam	87.2	99.8	58.8	49.0	0.56
York	87.4	104.2	60.2	53.2	0.56
Narrogin State Farm	87.1	104.2	58.7	51.0	0.00
Kalamang	82.1	100.8	52.1	40.5	0.03
Cape Leeuwin	81.4	100.2	54.3	44.3	0.18
	73.0	93.2	59.8	53.5	0.94

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SEYBERT J. HAYWARD, Director.

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**SUGAR BEET AND ITS CULTIVATION.**

GEO. L. SUTTON, Director of Agriculture.

The sugar beet has been developed from the ordinary beet of which the "Mangold" is one form—and its sugar content increased by selection, in order to render it suitable for the manufacture of sugar. It is, therefore, essentially a product for the factory, and the establishment of a factory is necessary for its profitable utilisation. The establishment of a beet sugar factory is, therefore, fundamental to the development of sugar beet farming, and each is necessary and complementary to the other.

Some farmers consider that sugar beet is a good fodder crop admirably suited for the dairy farm. Its cultivation for this purpose, however, is not justified, as its sister plant the "Mangold," "Mangel Wurzel" or "Wurzel," under similar conditions of soil and climate, can be relied upon to produce an equally good stock food at less cost.

Indirectly, however, the production of sugar beet is helpful to the dairy farmer, for after the extraction of the juice from the beets the residue is known as beet pulp, and this is an admirable stock feed. It is specially valuable because of its succulence which it has in common with other root fodders, and, like them, contains a large percentage (90 per cent.) of water.

This crop is, in effect, a garden crop which requires much labour and, in consequence, where the industry is established close settlement is required, and because of its association with a factory requiring large quantities of lime and fuel, it is a valuable complement to a secondary industry employing much labour. There are thus many advantages attached to the sugar beet industry, provided it can be established on economic lines. Consideration of the latter involves attention to three main factors—

- (1) The possibility of producing beets of high sugar content;
- (2) The cost at which sugar beets can be produced; and
- (3) The area of land surrounding a proposed factory site (and suitable in other respects) capable of producing commercially beets of satisfactory quality.



The first factor has already been determined and satisfactorily. In 1920, Plaistowe & Company, Limited, of Perth, interested themselves in this matter, and generously donated £100 as prizes for a sugar beet growing competition. There were 63 entrants in this competition from such widely separated places as Esperance, Southern Cross, Pemberton, and Pintharuka. This indicated great interest and enthusiasm, but also lack of information regarding the requirements of the plant. In consequence, it is not surprising though disappointing, that only five crops were submitted for judging. Some failed, because obviously the climatic conditions were unsuitable, others because the planting was carried out at unsuitable times, or the attention necessary for the cultivation of this intensive crop was lacking.

Whilst the competition was in progress a large number of seed samples were distributed to settlers not entered for the competition. From the resultant crops (including those of the competitors) the judge (Mr. Percy G. Wicken) had samples taken for analyses. He pointed out that, taking the first seven samples, which were grown in Southern and South-West districts, the average (sugar content) was 17.10 per cent., which is above that obtained by the American factories, their average being 16.28 per cent. sugar.

These results were confirmed by those from four experimental plots under the control of the Department of Agriculture, and supervised by Mr. Wicken. He reported that three varieties of sugar beet seed, viz., Vilmorin's "Improved White," "Klein Wanzleben," and "Domestic" were sown, and samples from the resultant crops were taken and submitted for analyses, with the following results:—

Location of Experiment Plot.	Percentage of Sugar.		
	Vilmorin's "Improved White."	"Klein Wanzleben."	"Domestic."
Balingup ... ..	20.31	20.13	22.49
Piesse ... ..	20.25	20.19	19.45
Capel * ... ..	11.76	13.94	14.80
Bridgetown ... ..	Failure	...	...

\* Stock obtained access to these plots.

It may, therefore, be taken as established that sugar beets of satisfactorily high sugar content can be grown in the Southern and South-Western areas of this State.

Interest in the establishment of the sugar beet industry has revived, and the Harvey Agricultural Society, believing that their district is suitably situated as regards water, fuel, and lime for the establishment of a beet sugar factory, have decided to obtain information regarding the two other fundamental points referred to. With this end in view they have requested, and the Hon. Minister for Agriculture has approved of farmers' trials with sugar beets being conducted in that district under the supervision of an officer of the Department. The prime object of these trials will be to determine the cost per ton of producing commercial sugar beets.

The information regarding the cultivation of this crop in Australia, and especially in West Australia, is meagre, but, fortunately, this crop has received

a great deal of attention by the experiment stations in the United States of America, and, in consequence, there is a wealth of information available for guidance in connection with the methods to secure the best results from the proposed trials.

The sugar beet is a summer growing plant, requiring summer temperatures for the production of sugar. As the result of very extensive experimentation in the United States of America, it has been definitely established that sugar beets can be grown for sugar production in regions which have a mean summer temperature of 70 deg. F., and with ample sunshine to promote sugar formation. In these respects our Southern districts may be regarded as satisfactory, for ample sunshine is undoubtedly available, and for the months of December, January and February the mean temperature at Bunbury, on the coast, and Donnybrook, a few miles inland, is 70 deg. F.

Ample soil moisture is also essential for the production of heavy sugar beet crops. At Maffra, Victoria, where a beet sugar factory has been established, the average annual rainfall is between 21 and 22 inches, but of this about half—over 10 inches—falls in the late spring and summer, when the crop is growing. Even with this average summer rainfall it is considered that irrigation is sometimes necessary to secure satisfactory results. In the South-West of this State, though the annual rainfall may range from 30 to 40 inches, only a small percentage falls during the summer months. At Harvey the average annual rainfall is 40.31 inches; of this 6.45 inches falls in the period October to March, inclusive. Only trials, such as are now proposed, can determine whether this limited summer rainfall, not supplemented by irrigation, is sufficient for profitable sugar beet production. Because there is some doubt as to whether this amount of summer rainfall is adequate, there is an insistent necessity that the grower shall use the utmost skill, as do our orchardists, in the preparation of the seed-bed and the cultivation of the growing crop, in order that the winter moisture may be conserved and summer evaporation reduced to the minimum.

Sugar beet cannot be grown under pioneering conditions; it is not a plant the seed of which may be sown and then left to take its chance until mature, as with wheat and other hardy cereals. Nor will it grow satisfactorily on all kinds of soils; poor sandy soils are unsuitable, as are also wet and cold ones. No particular soil is absolutely necessary, but it should be fertile and easy to work. The commercial sugar beet desired by the factory is a slender cone-shaped root, with a long single taproot, which extends over 12 inches and sometimes 24 inches into the soil. This requires not only a well-worked soil, but also a deep one, otherwise the undesirable clubby, badly-shaped forked roots, with two or more tap-roots are formed.

The work of the American experiment stations\* has shown that the heaviest yields of sugar beets, containing the highest percentage of sugar in the juice, are produced on rather heavy well-drained and fertile clay loams. On the lighter sandier soils the beets will mature earlier, but the yield of both beets and sugar per acre will be less than on the heavier soils. Sugar beets on peaty soils have generally given good yields, but the amount of sugar contained in the juice has been so low as to make their culture unprofitable. Hard clay soils should never be selected for sugar beets; on these soils roots are never able to penetrate deeply, and much of the root grows above the ground. This portion has to be cut away when "topping," occasioning a large loss in the yield of sugar. Heavy yields of

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\* *Farmers' Cyclopedia of Agriculture.*

sugar beets, and beets of excellent quality, have been obtained from many of the alkali soils of the Western United States. According to the Colorado Station, sugar beets containing a high sugar content and percentage of purity have been grown on soils showing a top encrustation of salts half an inch thick.

A deep well-tilled friable seed-bed is essential for the production of shapely commercial roots. In America the practice advocated is to plough in autumn to a depth of eight or nine inches, following the furrow with a subsoil plough to loosen the soil six or seven inches deeper.

In this State autumn fallowing or winter ploughing is obviously indicated. If late winter ploughing be practised, this should be carried out early enough to allow the ground to become moderately compacted and capillarity restored before the seed is sown. In the early spring the ground should be given such cultivation as is necessary to ensure perfect tilth. It must be emphasised again that this crop is a "garden crop," and that, because of the labour involved during the growth of this crop, "tilth before seeding and not after it" is essential. The plough, the cultivator, the roller and the harrow may be necessary to secure the desirable seed bed. Care to secure tilth prior to seeding will save much subsequent labour.

Sugar beet seed is imported from Europe, the best known varieties being "Klein Wanzleben" and "Vilmorin's Improved," and, for experimentation, either variety may be used with confidence.

The seed is sown in rows ranging from 18 to 28 inches apart. The width between the rows will be governed by the facilities for cultivating between the rows with a horse-drawn implement. For this reason it is anticipated that it will be found convenient to have the rows nearer 28 inches apart than 18. At Maffra, Victoria, the closer row is recommended.

It is essential to get a good stand of plants, and hence liberal seeding is advisable; it is better to use too much seed than too little. One of the unsatisfactory features of the Plaistowe competition already referred to was the tremendous number of "misses" in the rows, largely due to the unsatisfactory, irregular and scanty seeding. In Victoria 12 lbs. per acre has been found sufficient, though in the United States of America from 15 to 18 lbs. is recommended.

Sugar beets are about as exhaustive on the soil as other farm crops, but not more so. As the elements carbon hydrogen and oxygen, of which the sugar is composed, are obtained by the plant from the atmosphere and contain no fertilising ingredients, it follows that the crop would remove nothing from the ground if the tops as cut off were allowed to remain and the beet pulp returned and distributed over the land from which the beets were taken. This, however, is rarely if ever done, and so manuring of some kind is advisable, though the loss of fertility, due to the removal of the heavy crop, is greatly reduced, in most instances, by feeding the tops and pulp to the farm animals. In the trials carried out by the experiment stations in the United States of America,\* stable manure applied to the previous crop has given greater satisfaction than the use of any other fertiliser. When applied direct to the crop it is, however, likely to increase the yield, but to lower greatly the sugar content of the juice. Nitrogenous fertilisers, except in combination with phosphoric acid and potash, are to be applied sparingly, for used alone and in large quantities they were found to produce abnormally large beets which were low in sugar content.

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\* *Farmers' Cyclopedia of Agriculture.*

In Western Australia the use of superphosphate is undoubtedly necessary, and on new land, or following clover, may be all that is required, but pending definite information on this point a complete fertiliser rich in potash should be used. Commercial fertilisers should be applied in the spring and worked thoroughly into the ground before the seed is planted.

To ensure uniform distribution of the seed along the rows care is needed if it is hand sown. For large areas special seeders planting several rows at once are available, but for small plots the Planet Junior seed drill or similar implement is useful for sowing one row at a time. The seed should be drilled about  $\frac{3}{4}$  in. deep in moist conditions, and not more than  $1\frac{1}{2}$  in. under dry ones.

It is advisable that the seed should be planted as early in the spring as the seed will germinate readily, and in this State this will probably be during the months of September and October. While it is desirable that the seed be sown early, it is, however, equally desirable that the soil be warm enough to ensure good germination and a rapid growth of the young plants. If the seeds germinate when the ground is cold the young plants, like a young animal, may receive a "set back," from which they will never recover.

If the ground has been rolled just prior to and for the purpose of facilitating seeding a light harrowing after seeding may be advisable, particularly if the weather is dry, in order to mulch the surface and check evaporation. The harrowing, however, should be light enough as not to disturb the seed which should have been pressed into the firm soil.

Cultivation between the rows should commence as soon as the beets are through the ground, and so define the rows. The object of this inter-tillage is to keep down the weeds and to minimise evaporation. Some may question this latter, as it is obvious that the cultivated surface soil rapidly dries out; but the fact is that the soil moisture cannot readily pass through this layer of dry soil which acts as a blanket to prevent the loss of moisture (by capillarity) from below. In other words, the moisture in the first few surface inches is deliberately lost in order to protect the moisture in the feet below it.

The inter-tillage should be continued throughout the growing season whenever there are weeds to be destroyed, or when the loose dry mulch has been destroyed by rain, care being taken to see that the inter-tillage is not done when the ground is wet enough to be puddled by the passage of the horse and implement over it. The inter-tillage should be shallow and frequent. At first it should be level, but the later cultivations should throw the soil lightly towards the roots, as the portion above the ground has a low sugar content, and is cut off in topping the beets after harvest.

Since each seed ball contains several seeds and usually produces several plants, it is necessary to thin out the young beet seedlings. Hand labour is necessary for this, using narrow hoes for the purpose. With rows about 18 inches apart, thinning is carried out so as to leave individual plants about eight inches apart, but, as it has been found that best yields are obtained when individual beets have from 144 to 160 square inches feeding area, it is recommended that with a greater width between the rows, say 28 inches, the spacing between individual plants in the rows should be closer, say six inches, the object being to produce roots averaging between one to two lbs. rather than heavier ones, as the sugar content of large beets is less than that of the smaller ones.

Thinning should be carried out so as to provide for—

- (a) the selection of the strongest beets;
- (b) their even distribution in the rows; and
- (c) the destruction of all weeds in the rows and immediately around the beets.

Thinning was stated by Easterby, the Manager of the Maffra Factory, to be, without exception, the most important act in beet cultivation. The following is an outline of the process as described by him:—

“With a sharp four to five inch hoe cut out the young plants so as to leave a two-inch bunch of beets standing every four to five inches. Immediately behind the spacer with the hoe, come the thinners, who should pull out all beets left in the bunch, except the healthiest and strongest plant. This should be done by gently pressing the fingers around the chosen beet while pulling out the others, taking care that the roots are pulled out as well as the leaves, otherwise they would grow again. The earth should be carefully but firmly pressed around the plant that is left, and any weeds in the row should at the same time be eliminated. The thinner should then pass to the next bunch. Great care should be exercised that no double plants are left. The distance left between the plants should, as nearly as possible, be eight inches, only varying this distance when a stronger or better beet is found at a slightly differing distance. In practice this work is quickly done, and the above rules are not altogether adhered to, thinners often providing themselves with different shaped knives adapted to cutting out or selecting beets. The spacing with the hoe, however, is a great advantage, and makes the work of pulling easier. It also helps to get rid of weeds where these exist. Hand weeding should be done up to the part of the row where the horse cultivators have gone. A field of thinned beets has a very wilted and woebegone appearance for a day or two and might give a novice the idea that all the beet had been killed. The disturbed plants quickly take hold again, and, if the season is good and cultivation well looked after, it is really surprising the amount of growth that takes place within the few weeks following thinning.”

Sugar beets are ready to harvest when the outside leaves have a yellowish tinge and drop to the ground. The more mature the beets are before being pulled the greater will be the sugar content. The previous trials indicate that the harvesting season will commence at the beginning of March, and may extend to the end of April. The American experience\* is that the roots may remain for a considerable time after ripening in the ground without injury. Freezing does not harm them provided they are kept frozen, but freezing and thawing is very injurious. If autumn rains occur while beets are in the ground they are likely to make a second growth, and this causes a decrease in the sugar content. At the Nebraska and Indiana Stations it was found that the second growth was prevented by loosening the roots in the ground sufficiently to break them. This practice had a favourable effect on the sugar content and the percentage purity of the juice. When this is not done the beets should be harvested and stored before the autumn rains come.

For harvesting the beets, Easterby considered that, “apart from machines specially built for harvesting beet roots—none of which is as yet an unqualified success—the best implement for lifting beet roots is the ordinary ‘Oliver’ or

\* *Farmers' Cyclopedia of Agriculture.*

similar plough, deprived of its mould board. This plough runs along the rows with its share under the beet, which it so loosens that they can be easily pulled out by hand and thrown into heaps ready for topping. Topping the beet consists of removing the leaves and collar with one blow from a large knife so that the entire portion upon which leaves have grown shall be cut off. When the ground has been properly subsoiled the roots have plenty of room to grow downwards, but, if shallow ploughing has been done, the roots are forced up by the hard pan beneath and the portion required to be removed is much longer, and consequently the loss is greater from a commercial standpoint."

The yields range up to 30 tons per acre. A good average yield is 11 to 12 tons.

There is a considerable variation in the price obtained by the farmer for topped sugar beets. Mr. P. G. Wicken, in his report dealing with the Plaistowe Competition, stated that at Maffra the price per ton had ranged from 16s. in 1910-11 to 27s. 6d. in 1919, and the average American price at that time (1921) was 7.39 dollars, equivalent at par rates to £1 10s. 9½d. Since then the price has improved considerably. In a letter dated 8th December, 1930, dealing with this and other cognate matters, Mr. Williams, the present manager of the sugar factory at Maffra, points out—

"The average yield of clean topped beet per acre ranges between 11 and 12 tons.

"The quantity of beet required for 1 ton of sugar varies with the sugar content, but ranges from 7 to 8 tons.

"The cost per ton varies largely according to sugar content and turnover, as the overhead expenses such as repairs, interest and depreciation are fairly constant. Beets will cost £15 to £17 per ton of sugar; interest and depreciation may cost £3 per ton of sugar; manufacture and repairs, £10 to £15 per ton of sugar, according to sugar content and turnover.

"The price of beets in 1929 at the factory was 44s. a ton; from most of the sidings the freight is only 1s. 1d. to 2s. per ton."

In connection with the sugar beet industry Mr. Williams, in another letter dated the 17th December, 1930, stated: "The industry is a splendid one for the employment of labour in the country, and is a profitable crop to grow under present conditions. The difficulty at present is an economic one—Queensland is producing far more sugar than Australia requires and is, therefore, exporting large quantities at a loss, so that the further expansion of sugar production is increasing this difficulty."

The conditions\* affecting the establishment of a factory (capacity say, 300 tons beet per day) in any neighbourhood, after it has been proved by trials that sugar beets of satisfactory quality can be grown are—

- (1) suitable transportation facilities for both the raw beets and the refined sugar;
- (2) a guarantee of the annual production of a sufficient quantity of beets (say, 21,000 tons from 2,000 acres) to keep a factory working to its capacity during the harvesting season;
- (3) an abundant supply of good water;
- (4) a daily supply of 50 tons of coal, or its equivalent in wood and 20 tons limestone;
- (5) competent labour at reasonable rates;
- (6) economic methods for handling the pulp, either by feeding to stock or preparing for market.

\* *Farmers' Cyclopaedia of Agriculture.*

## REGISTRATION OF BEES.

All persons keeping one or more hives of bees are required by "The Bees Act, 1930," to register as an apiary with the Department of Agriculture.

If the bees are kept in separate apiaries, each apiary must be registered.

Any person or persons allowing another person to keep bees upon their property are responsible to see that such bees are registered either by the owner or by themselves.

The fees for registration are one shilling for from one to ten colonies, and half-a-crown for over ten colonies.

Application should be made at once to the Department of Agriculture for registration forms.

Defaulters are liable to a penalty of Five pounds.

## TRIALS WITH SANTA FÉ LUCERNE.

### MERREDIN EXPERIMENT FARM.

E. J. LIMBOURN, Cereal Breeder.

Seed of a variety of lucerne known as "Santa Fé," which originated in the Argentine, was supplied to the Department of Agriculture. Portion of this seed was forwarded to the Merredin Experiment Farm for trials under our wheat belt conditions.

It was planted alongside the standard variety, "Hunter River," on 14th May, 1929, and germinated readily, being well up by 22nd May.

Both varieties received an equal dressing of superphosphate at seeding time, and were hand cultivated and kept free of weeds during growth.

Very little growth was made until after the rains early in November, but the "Hunter River" was decidedly the better of the two throughout the season. Both varieties were cut on 5th December, with the following results:—

				Average Height.		Green Weight.
Santa Fé	...	...	...	14 inches	...	1 lb. 14 $\frac{3}{4}$ ozs.
Hunter River	...	...	...	18 "	...	2 lb. 12 $\frac{1}{2}$ ozs.

In the following year two cuts were made, the first on 16th April, 1930, and the second on 1st September, 1930, the results being as follow:—

First cut, 16th April, 1930—				Average Height.		Green Weight.
Santa Fé	...	...	...	8 inches	...	$\frac{1}{2}$ lb.
Hunter River	...	...	...	12 "	...	1 $\frac{1}{2}$ lb.
Second cut, 1st September, 1930—						
Santa Fé	...	...	...	18 inches	...	14 $\frac{1}{2}$ lb.
Hunter River	...	...	...	24 "	...	15 $\frac{1}{2}$ lb.

After the cutting in September practically no further growth was made by either variety, owing to the absence of rain after that date.

From the observations, extending over two years, upon the growth of the "Santa Fé" lucerne under conditions prevailing in the wheat belt, it is not anticipated that this variety will replace the standard variety "Hunter River," which not only produced a greater weight of greenstuff, but also came away much quicker after the first early rains.

## FALLOW COMPETITION.

### PHILLIPS RIVER AGRICULTURAL SOCIETY.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

The 50-acre Fallow Competition conducted by the Phillips River Agricultural Society comprised two sections, making provision for heavy and light land respectively. Nine fallows in the heavy land section, and three in the light land section were inspected, the awards being as follow:—

#### PHILLIPS RIVER FALLOW COMPETITION.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

Competitor.	Moisture, 40 pts.	Mulch, 10 pts.	Freedom from Weeds, 10 pts.	Consolid- ation of Seed Bed, 20 pts.	Uniform- ity of Prepara- tion, 20 pts.	Total, 100 pts.
<i>Heavy Land.</i>						
E. Shinner ... ..	37	9	8	17	19	90
J. McCulloch ... ..	38	9	8	16	18	89
J. W. Love ... ..	35	8	9	17	18	87
E. Newton ... ..	33	7	9	18	18	85
Chambers Bros. ... ..	34	7	7	17	18	84
C. G. Mitchell ... ..	35	8	7	17	17	84
Barrett Bros. ... ..	33	8	7	17	17	82
I. J. Chapman ... ..	30	8	9	16	18	81
S. C. B. Dunsborough ... ..	25	6	7	16	16	70
<i>Light Land.</i>						
W. H. Smith ... ..	36	8	8	19	17	88
W. E. Reynolds ... ..	35	7	7	16	17	82
Bebbington Bros. ... ..	33	7	8	16	17	81

The detailed cultural methods employed by the competitors are shown here under:—

#### CULTURAL DETAILS.

##### HEAVY LAND.

Competitor.	Timber.	Ploughed.	Type of Plough.	Depth of Plough- ing.	Condition of Land at Ploughing.	Other Cultivations.
E. Shinner ...	Ginlet and mallee	July	Mouldboard	inches. 4	Good	Springtyne cultivated end of August and portion again early in September.
J. McCulloch ...	Mallee ...	July	Mouldboard	4	Good	Springtyne cultivated early August.
J. W. Love ...	Salmon gum and mallee	July	Mouldboard	4	Fair	Springtyne cultivated twice in August and twice in September; half was disc'd ploughed to the full depth of 4in. at the end of September.
Chambers Bros.	Salmon, ginlet and mallee	Early July	Mouldboard	4	Good	Springtyne cultivated in August
C. G. Mitchell ...	Black mallee	Early July	Disc	5	Wet	Springtyne cultivated twice in September.
Barrett Bros. ...	Ginlet, salmon and mallee	Late June	Disc	4	Wet	Springtyne cultivated in August.
I. J. Chapman...	Mallee and ginlet	Late July	Mouldboard	3½	Good	
S. C. B. Dunsborough	Salmon, ginlet and mallee	Early August	Disc	2	Hard	



## LIGHT LAND.

W. H. Smith ...	Scrub-plain— odd sheoaks	Early July	Disc	4	Excellent	Disced 2in. deep in August.
W. E. Reynolds	Mallee sand- plain	July	Disc	4	Good	
Bebbington Bros.	Mallee ...	Early July	Mouldboard	3½	Wet	Springtyne cultivated early October.

The following table shows the monthly rainfalls as recorded at Ravensthorpe from June, 1930, to February, 1931.

	1930.							1931.		Total, June to Feb.
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	
Ravensthorpe ...	163	149	135	76	55	42	15	8	26	669

The rainfall diminished after the end of August and consequently it was difficult to work the fallows satisfactorily after this month. Considering this fact, most of the fallows inspected were of a reasonably good standard.

The entry of Mr. E. Shinner was placed first in the heavy land section, with a total of 90 points. This was a good fallow which showed thorough workmanship. During the previous July it had been ploughed, with a mouldboard plough, to a depth of four inches. Towards the end of August the land was springtyne cultivated, this cultivation being repeated over a portion in order to eradicate thistles. The mulch was comparatively good and the moisture content high.

Mr. J. M. McCulloch's competing area had received working similar to that of Mr. Shinner's. The mulch was good except where patches had ploughed up rather cloddy. The moisture content was also comparatively high, being at a depth of about eight inches below the surface. This fallow, however, lost points owing to insufficient consolidation.

Mr. J. W. Love's entry was placed third. The first springtyne cultivation was to the full depth of the ploughing whilst the succeeding three were to a lesser depth. After receiving the fourth cultivation half of the fifty-acre plot was disced to a depth of four inches in order to deal with weeds. This destroyed the mulch and consolidation, and probably affected the moisture content, which was considerably below that of the remaining portion. The portion which had not received the final disc ploughing was the outstanding fallow inspected, having a high moisture content, a well consolidated seed bed, a good mulch and little or no weed growth.

In the light land section Mr. W. H. Smith's entry was awarded first place. The soil was a loamy sand, the location being on a river flat. The fallow had but little weed growth and the consolidation of the seed bed was good. In places the mulch was a little too rough.

If better spring rains had fallen no doubt the fallows in the Phillips River competition would have received further cultivation. Most of the competitors contrived to plough not later than July, the mouldboard plough being more generally favoured than the disc implement. The importance of early and thorough ploughing for most types of soil should be particularly emphasised. Continued experiments at the experiment farms have shown repeatedly the value of early over late fallow—the value of thoroughness is self-evident.

## 50-ACRE FALLOW COMPETITIONS, 1930.

Judge—G. L. THROSSALL, Dipl. Agric., Agricultural Adviser.

Fallow competitions were conducted during the past season by the Nungarin, Merredin, and Bruce Rock Agricultural Societies and were judged towards the end of January of this year. A falling-off in the number of entries was noticed, this being due to the unsettled state of the industry rather than to a decline in the appreciation of fallow competitions. Those competitors who did participate are to be commended for their keenness despite the unfavourable economic conditions which are disturbing wheat farmers.

All the competitions were judged under the same scale of points, viz.:—

Moisture	..	..	..	..	..	..	..	40	pts.
Condition of mulch	..	..	..	..	..	..	..	10	„
Freedom from weeds	..	..	..	..	..	..	..	10	„
Consolidation of seed bed	..	..	..	..	..	..	..	20	„
Uniformity of preparation	..	..	..	..	..	..	..	20	„

### NUNGARIN FALLOW COMPETITION, 1930.

Six entries were received for this competition and three entries were submitted for judging—ten less than in the previous competition.

The rainfall recorded at Mukinbudin and Nungarin from June to December was as follows:—

	Fallowing Rains.				Spring Rains.			Summer Rains.			Total, May-Dec.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Total.	
Nungarin ...	324	196	155	675	80	21	101	1	101	102	878
Mukinbudin ...	397	142	174	713	128	16	144	5	66	71	928

The points awarded are shown in the following table:—

### NUNGARIN AGRICULTURAL SOCIETY.

#### 50 ACRE FALLOW COMPETITION, 1930.

Judge: G. L. Throssall, Dipl. Agric., Agricultural Adviser.

Competitor.	District.	Moisture. 40 pts.	Condition of Mulch. 10 pts.	Absence of Weeds. 10 pts.	Consolida- tion of Seed Bed. 20 pts.	Uniformity of Pre- paration. 20 pts.	Total. 100 pts.
Creagh Bros., Ltd. .	Kwelkan ...	83	8	8	18	18	90
Williams, F. A. ...	Mangowine ...	37	7	7	19	18	88
Duthie, W. ...	Mukinbudin ...	36	7	7	18	18	86

The competition was won by Creagh Bros., of Kwelkan, with an entry which was awarded 90 points. The land originally carried salmon gum, gimlet and yorrel, portion of which was cleared in 1914 and the balance in 1921. This paddock is worked on a two-year rotation, viz., fallow-wheat. The entry was early fallow, being ploughed 3-4 inches deep with a disc plough at the end of June and early July. Sheep were run on the fallow during the remainder of the winter to keep the weeds in check. In September it was cultivated with a rigid tyne scarifier. The mulch was in a good condition and of uniform depth, excepting in places where the soil had been rather wet when ploughed and at the time of inspection was rather cloddy. This entry scored well for moisture content and, excepting for a little barley grass which had seeded, was free of weeds. These farmers have been consistent supporters of fallow and other competitions since their inception and this is the first occasion on which they have been successful in winning a fallow competition.

The entry of Mr. F. A. Williams, of Mangowine, was placed second, being awarded 88 points. This entry, which consisted of salmon gum and gimlet country, was worked to a depth of 3 inches with a rigid tyne scarifier in June, harrowed in July, and rigid tyne scarified again in August. The harrowing in July caused the mulch to become too fine and shallow. Potato weed (*Solanum hoplopetalum*) was much in evidence.

The cultural details of the competitors have been summarised in the following table:—

NUNGARIN AGRICULTURAL SOCIETY.

50 ACRE FALLOW COMPETITION.

*Cultural Details.*

Com- petitor.	Timber.	When cleared.	Rotation.	When plough- ed.	Imple- ment.	Depth.	Con- dition of land.	Subsequent cultivations.	Sheep.	Points award- ed. 100.
Creagh Bros., Ltd.	Salmon, gimlet, yorrell	1914 and 1921.	2 years, Fallow Wheat	June- July	Disc	ins. 3-4	Wet	Rigid tyne scarified in September	Yes	90
Williams, F. A.	Salmon, gimlet	1912	2 years, Fallow Wheat	June	Rigid- tyne scarifi- er	3	Good	Harrowed July, rigid-tyne scarified and harrowed Aug.	Yes	88
Duthie, W.	Gimlet, malbec and scrub	1923	2 years, Fallow Wheat	June	Disc	4	Good	Springtyne cultivated August	...	86

## MERREDIN FALLOW COMPETITION, 1930.

Eight of the eleven entries received for the competition were judged, being four less than in the previous competitions.

The rainfall from June to December was as follows:—

	Following Rains.				Spring Rains.			Summer Rains.			Total, June- Dec.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Total.	
Koonadgin ...	401	203	180	784	84	20	104	4	89	93	981
Ulva ...	383	247	256	886	91	36	127	...	81	81	1,094
Nangeenan ...	325	177	220	721	81	44	125	4	85	89	945
Nukarni ...	314	182	178	674	43	12	55	...	125	125	854

The awards are shown in the following table:—

## 50 ACRE FALLOW COMPETITION, 1930.

## MERREDIN AGRICULTURAL SOCIETY.

Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.

Competitor.	District.	Moisture.	Con- diti- on of Mulch.	Absence of Weeds.	Con- solid- ation of seed-bed.	Unifor- mity of Prepara- tion.	Total.
		40 pts.	10 pts.	10 ms.	20 pts.	20 pts.	100 pts.
Cook, W. T. ...	South Burracoppin	37	8	9	19	19	92
Teasdale, H. W. ...	Totadgin ...	38	8	8	19	18	91
Rowan, C. H. ...	Totadgin ...	36	8	8	19	18	89
Clothier, J. H. ...	Totadgin ...	37	8	7	19	18	89
Smallacombe, T. H. ...	Nangeenan ...	36	8	8	18	18	88
Zwar, A. T. ...	Merredin ...	36	7	8	18	18	87
Lambert, J. B. ...	South Burracoppin	35	7	8	19	18	87
Cockram, W. H. ...	Nukarni ...	30	7	7	18	17	85

The winner of the competition was Mr. W. T. Cook, of South Burracoppin, whose entry was awarded 92 points. This entry was ploughed with a disc cultivating plough in July, 1930, springtyne cultivated in August, and rigid tyne scarified in September. This was a very uniform piece of fallow, having an even mulch overlying a well consolidated level seed bed.

Mr. H. W. Teasdale's entry was placed second with 91 points. This fallow was prepared by ploughing in June-July with a mouldboard plough, when the ground was in a very wet condition, and consequently it worked up in a very lumpy condition. It was rigid tyne scarified in August and October, and harrowed at the end of October.

The cultural details of the competitors are summarised in the table hereunder:

MERREDIN FALLOW COMPETITION.  
CULTURAL DETAILS.

Competitor.	Original timber.	When cleared.	Rotation.	When ploughed.	Implement.	Depth of ploughing.	Condition land.	Subsequent cultivations.	Sheep.	Points awarded, 100.
Cook, W. T. ...	Ginlet and mallee	1924	2 year—Fallow, wheat	July	Cultivating disc	inches. 4	Good	Springtyne cultivated Aug. Righttyne scarified Sept.	No	92
Teasdale, H. W. ...	Ginlet and little salmon	1916	2 year—Fallow, wheat	June—July	Mouldboard	4	Very wet	Righttyne scarified Aug. and Oct. Harrowed end Oct.	Yes	91
Rowan, C. H. ...	Salmon and ginlet	1918	3 year—Fallow, wheat, pasture	June	Mouldboard	3-4	Good	Righttyne scarified Aug. ...	Yes	89
Clothier, J. H. ...	Mallee and jam scrub	1916	3 year—Fallow, wheat, pasture	June	Mouldboard	8	Good	Springtyne cultivated Aug.	Yes	89
Smalacombe, T. H.	Salmon, ginlet, mallee and jam	1926	2 year—Fallow, wheat	July	Disc.	4	Good	Disc cultivated Sept. ...	Yes	88
Zwar, A. T. ...	Mallee, tea-tree and jam scrub	1925	3 year—Fallow, wheat, pasture	July	Mouldboard	4	Good	Cultivated with combined cultivator drill with harrows attached, Sept.	No	87
Lambert, J. B. ...	Ginlet	1925	2 year—Fallow, wheat	June	Disc cultivating	3-4	Good	Disc cultivated Aug. Righttyne scarified and harrowed Aug. and Sept.	No	87
Cockram, W. H. ...	Ginlet, jam, mallee, and tea-tree	1912	3 year—Fallow, wheat, pasture	July	Disc cultivating	4	Good	Disc cultivated Aug. Springtyne cultivated Nov.	...	85

## BRUCE ROCK FALLOW COMPETITION, 1930.

Six entries were judged in the Fallow Competition conducted by the Bruce Rock Agricultural Society, the awards being as follows:—

## 50 ACRE FALLOW COMPETITION, 1930.

## BRUCE ROCK AGRICULTURAL SOCIETY.

Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.

Competitor.	District.	Moisture. (40 pts.)	Condition of Mulch. 10 pts.	Absence of Weeds. 10 pts.	Consolida- tion of Seedbed. 20 pts.	Uniformity of Pre- paration. 20 pts.	Total. 100 pts.
Brown, S.A. ... ..	Bungulluping	38	9	9	19	18	93
Smith, C., & Sons ...	Yarding ..	37	9	9	19	18	92
Schilling, C. E., & N. S.	Bungulluping	37	8	9	19	18	91
Allen Bros. ... ..	Central Kummudu	36	8	9	18	18	89
Farrall, F. C., & Sons	Yarding ...	26	8	8	18	17	87
Strange, P. ... ..	Yarding ...	35	7	8	18	17	85

The winner was Mr. S. A. Brown, of Bungulluping, his entry being awarded 93 points. The land, which originally carried salmon gum and gimlet, and which was cleared in 1914, was ploughed with a mouldboard implement in June-July, 1930, to a depth of 3 inches. It was rigidtyne scarified at the end of August and early September, and springtyne cultivated at the end of September and early October. This was an attractive piece of fallow, the mulch being of uniform depth and in a desirable tilth.

Messrs. C. Smith and Sons, of Yarding, entered the fallow which was awarded second place. Excepting the winning fallow, which had a slightly better moisture content, there was little between these two competing areas.

The rainfall recorded from June to December was as follows:—

	Winter Rains.				Spring Rains.			Summer Rains.			Total, June-Dec.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Total.	
Bungulluping ...	209	262	218	770	152	47	199	6	18	24	1,002
Yarding ...	380	252	194	826	121	31	155	...	15	15	996
Cent. Kummudu	367	303	136	806	133	29	162	9	35	44	1,012

The cultural details of the competitors are shown in the accompanying table:—

50 ACRE FALLOW COMPETITION.  
BRUCE ROCK AGRICULTURAL SOCIETY.  
CULTURAL DETAILS.

Competitor.	Timber.	When cleared	Rotation.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Sheep.	Points Awarded, 100 points.
Brown, S. A. ...	Salmon and gimlet	1914	2 year—Fallow, Wheat	June—July	Mouldboard	3in.	Good	Ridgityne scarified Aug.—Sept.; springtyne cultivated Sept.—Oct.	Yes	93
Smith, C., & Sons ...	Salmon and gimlet	...	... ..	June ...	Disc ...	3in.	Good	Disc cultivated July—Aug.; rigidtyne scarified Sept.	Yes	92
Schilling, C. E. & N. S.	Salmon and gimlet	1922	2 year—Fallow, Wheat	June ...	Mouldboard	3in	Good	Harrowed end of June to kill weeds; skim ploughed with mouldboard early August; springtyne cultivated early September	Yes	91
Allen Bros. ...	Salmon and gimlet	1927	2 year—Fallow, Wheat	End June	Disc cultivating	3in.	Good	Springtyne cultivated August	Yes	90
Farrall, F. C., & Sons	Salmon, gimlet and morrel	1912 & 1921	2 year—Fallow, Wheat, Stubble	June ...	Mouldboard	4in.	Good	Disc cultivated August	Yes	87
Strange, P. A. ...	Salmon, gimlet and mallee	1924	Fallow, Wheat, Wheat	June—July	Disc cultivating	3in.—4in.	Patchy	Disc cultivated Sept.—October	Yes	85

A noticeable feature of the three fallow competition judged this year was that all the competing areas were ploughed during the months of June and July. The time of ploughing is one of the most important factors in connection with the production of maximum wheat yields. This has been clearly demonstrated by experiments conducted, not only at the Merredin Experiment Farm, but also at the other experiment farms. At Merredin, where the land is of a similar nature to that of the Nungarin, Merredin and Bruce Rock districts, namely, salmon gum and gimlet forest country, a time-of-ploughing experiment has been conducted continuously since 1924. The results, shown below, leave no doubt that early June fallow is the best fallow.

Time of Ploughing.					Average Yield per Acre, 1924-29.		Percentage Yield, 1924-29.
					bus.	lb.	per cent.
First week in June	...	...	...	...	18	46	100
Last week in August	...	...	...	...	14	55	80
Difference	...	...	...	...	3	51	20

Last year the experiment was slightly modified, an intermediate plot being included, the times of ploughing being respectively mid-June, mid-July, and mid-August, the results obtained being as follows:--

Time of Ploughing.					Average Yield per Acre, 1930.		Percentage Yield, 1930.
					bus.	lb.	per cent.
Mid-June	...	...	...	...	28	0	100
Mid-July	...	...	...	...	22	48	81
Mid-August	...	...	...	...	20	16	72

The results also show that ploughing should be commenced immediately after seeding has finished, and that as much as possible should be done during the early winter months.

As has been previously pointed out, the type of implement used for ploughing is not so important, provided that the implement used is suited for the purpose, enabling the work to be done thoroughly. On land which has been cleared for some time and which has become compacted, it will be found that the heavier types of ploughs do better work than the lighter cultivating ploughs. Where the heavier implement is used, hard patches are less evident and the mulch is more uniform.

Experiments on salmon gum and gimlet country at the Merredin Experiment Farm indicate that ploughing to a depth of four inches is the most economical. There is also evidence that deeper ploughing is not detrimental on this class of country, providing the subsequent cultivations produce a consolidated seed bed.



As a consequence of the low price prevailing for wheat, it is imperative that working costs should be reduced to a minimum. In this respect the mulching experiment supplies the farmer with information as to the working of the fallow. This experiment, which has been conducted continuously since 1915, shows that the fallow should be given a thorough cultivation in the spring and again prior to seeding. Frequent cultivation after summer rains is not profitable; moreover it is often found that such cultivation "fines up" the mulch too much, with the result that it sets after heavy rains. A cultivation during the summer is necessary only when there has been sufficient rain to cause the mulch to run together or to destroy weed growth.

The correct use of harrows on forest country is not properly understood. Generally speaking, the harrows should not be used on forest country until the autumn months. If used early they make the mulch too fine and flatten the surface, so that in many cases they do more harm than good. The fallow during the summer months should have a corrugated surface and the mulch in such a tilth that the larger clods are the size of an average man's fist. The mulch should also be at least 2-2½ inches deep. It is preferable for the fallow to be a little too cloddy during this period rather than too fine as the former condition can be remedied by the cultivation prior to seeding, whereas the latter is certainly a defect, and more difficult to overcome. If the tilth of the fallow is as it should be, then the use of harrows after the autumn rains is often an advantage, as they enable a large area of the fallow to be covered in a short time and assist in the germination of weeds which can be destroyed by the subsequent cultivation. When harrows have been used, the next working should be done with a tynd implement such as a syringtyne or rigid tyne cultivator. The use of the harrows should be avoided on clay country or soil types which easily run together after rain.

The Potato Weed or Summer Thistle (*Solanum elaeagnifolium*) is becoming prevalent on fallows in the Eastern Districts. This weed is a deep-rooting perennial which is of consequence only on fallowed land. It does not grow in direct competition with the crop like many other weeds, but by depleting the moisture in the fallowed land on which it is growing during the summer, it has a harmful effect on the crop, especially in a dry season. There are two ways in which this weed spreads: on the surface by seeds and underground by roots. Its control, therefore, rests in the prevention of the formation of seeds and the destruction of surface growth. This can be done by summer cultivation, preferably with a disc implement. When the weed first makes its appearance in a paddock, it should be grubbed out and not left until it has obtained a strong hold before control methods are employed. There are many places where this weed is only making its appearance, and farmers are advised to take measures for its control while the opportunity presents itself.

A few of the areas inspected had plants of Wild Turnip in evidence. On these fallows and those over which the matured plants of the weed had been seen blowing about, it will be advisable to delay seeding until after the first seeding rains in order that the seeds of this noxious weed might be given a chance to germinate and then be destroyed by cultivation prior to seeding.

## HORTICULTURAL NOTES.

GEO. W. WICKENS.\*

Superintendent of Horticulture.

*Apples, Pears, Stone Fruits.*—At time of writing these notes (25.5.31) the deciduous fruit crop of season 1930/31, with the exception of a few late varieties of apples, is gathered, the major portion sold, and growers are once more examining fruit buds endeavouring to estimate from their appearance what next season's harvest is likely to be. To a number of orchardists the present season has been one of keen disappointment and loss, while to others, more fortunately situated, it has been highly profitable. Thrip was the factor that turned what promised to be a record crop (judging by bud development) in the apple growing districts near the Great Southern Railway line, from Katanning to Albany, into the worst failure experienced for many years. And the bad effect of the pest spread as far west as Dinninup, and portions of Boyup, and did some damage, but to a much less extent, to apple orchards near Bunbury and in the hills near Perth. Contrasting with the failure along the Great Southern line was the heavy crop obtained in the orchards near the south-west line from Boyanup to Pemberton, including the Upper Preston and Upper Capel. In this portion of the State in many orchards there was a greater number of apples on the trees than I have previously seen, but I doubt if the final reckoning will show a record yield, as much of the fruit failed to reach average normal size owing to a long spell of dry weather in the growing period, and the trees being too heavily laden. If the experience gained convinces growers of the necessity for thinning in the heavy cropping years it will not have been without some compensation. Cases and cases, and yet more cases, of "two-inch Cleos" should convince anyone that there is a limit to a tree's capacity, and if anything further is needed "two-inch Nickajacks" should supply it. Orchardists should make a note and paste it in their hats that in the year of heavy crops "thinning" is just as essential as cultivation.

It is fortunate for the State that the apple crop was not a failure in all districts, for it has enabled sellers to keep in touch with buyers overseas and prices obtaining, especially when exchange is taken into consideration, are quite good.

The total quantity of apples shipped from 1st January to 15th May amounted to 442,068 cases, and there are a few thousands still to go. The total shipments of all kinds of fruit for the period mentioned comprised 505,178 cases, and nothing gives a better conception of the failure in the southern districts than the fact that only 32,617 cases were shipped from Albany. The orchardists who use that port usually supply one-third of the total quantity exported in any year, and if thrips had not intervened their quota this season would have easily reached 250,000 cases.

The pear and stone fruit crops were lighter in all districts than the average in recent years, the pears exported only amounting to 16,182 cases.

*Grapes.*—The Western Australian grape crop suffers less from crop fluctuation than any other kind of fruit (excepting lemons) produced here, and though the quantity of fresh grapes exported is not large when compared with apples, it ranks second on the list, and is remarkably uniform from year to year. For instance, during the last five seasons 38,210 cases were exported in 1927; 41,142 in 1928; 48,683 in 1929; 43,052 in 1930; and 46,444 in 1931, with a few more ex cold store still to be shipped.

Of the varieties used for drying purposes, currants were heavier, while lexias and sultanas were lighter than usual. From the commencement of the season in February of this year to 16th May, in the six dried fruit packing sheds in the Swan and Greenmount districts, the total quantities received and packed were as shown hereunder: Four of the sheds mentioned have still a quantity of fruit on hand which is now being processed, and there is also a small packing shed at Coolup for which I have not returns, but the figures quoted indicate that the currant crop will be the largest produced in the State up to the present:—

Received.					Packed.				
	tons.	cwts.	qrs.	lbs.	tons.	cwts.	qrs.	lbs.	
Currants ... ..	1,724	12	3	7	1,525	16	3	...	
Lexias ... ..	287	9	3	6	196	10	3	16	
Sultanas ... ..	183	13	3	...	138	4	2	...	
	2,195	16	1	13	1,860	12	...	16	

The steady increase in currant production during the past five years is interesting and is as follows: 1,146 tons in 1927; 1,221 tons in 1928; 1,290 tons in 1929; 1,332 tons in 1930; 1,525 tons packed up to the 16th May, 1931, with more on hand now being processed.

The export of this season's dried vine fruits up to the 16th May comprised—1,154 tons of currants and 82 tons of lexias.

*Citrus.*—The orange crop in Western Australia ranges annually from 200,000 to 260,000 cases; the heaviest crop recorded being in 1923 with 264,160 cases, and the lightest in the past seven years for which returns are available was in 1925—193,346 cases. I believe last season's crop was equal to that quoted for 1923, but definite figures are not yet to hand and I estimate this season's crop at 210,000 cases.

The mandarin crop ranges annually from 12,000 to 20,000 cases, and I estimate this season's crop at 13,000 cases.

As mentioned above, the lemon crop is not subject to big variations from year to year, ranging from 51,000 cases to 59,000 cases. I estimate this season's crop at 58,000 cases.

*General.*—The low prices obtaining for oranges during last winter, and the quantities that fell off the trees during a short spell of violent weather were no doubt indirectly responsible for carrying over fruit fly to a greater extent than for many years past. If the fruit had been higher in price much greater care would have been exercised in gathering it both from the trees and ground, and infested fruit would then have been seen and destroyed, instead of remaining to carry along the pest. I do not say the above was the only, or even the main, cause of the big carry-over, the primary factor being the comparatively long periods of mild, genial weather, but it certainly contributed to the result and growers of Late Valencias which this year were carried on the trees in quantities until March and April, suffered from losses by fruit fly infestation almost equally with stone fruit growers.

Apple and pear growers will be pleased to know that the whole season has passed without any appearance of Codlin Moth either in fresh orchards or orchards previously infested, and another piece of cheering news is the good results obtained in the work done towards eradication of Apple Scab (*Venturia inaequalis*). In Mr. Brealey's orchard at Manjimup no trace of the disease has been seen during the

whole season, and he certainly deserves success, for the work he did was exceedingly thorough. In his case the old saying that misfortunes rarely come singly was well exemplified, for a hailstorm in summer that affected only a very small portion of the district, hit his orchard badly and did considerable damage to the apples. In the Porongorups orchard, where Apple Scab was found last year, only one apple was found affected this year and that was early in the season, so that next year's operations should free this orchard from the disease.

## FARMERS' FIELD TRIALS, 1930.

A. S. WILD, B.Sc. (Agric.), Agricultural Adviser.

### ON THE PROPERTY OF C. O. TRANTER, PINGRUP.

During 1930 two experiments with wheat, viz., a Wheat Variety Trial and a Rate of Superphosphate Trial were conducted at Pingrup on the property of Mr. C. O. Tranter.

The plots were located about  $3\frac{1}{2}$  miles South of Pingrup and were planted on a clay loam, which originally carried blackbutt and boree timber. This had been cleared in 1925, the 1930 crop being the fourth to be grown thereon.

During June, 1929, the land was ploughed with a disc implement to a depth of  $3\frac{1}{2}$  inches. This was followed by a springtyne cultivation in September and a harrowing in November, after rain had fallen. Towards the end of March the springtyne cultivation was repeated and the plots finally sown on the 9th and 10th of May by means of a combined cultivator-drill.

Each plot was half an acre in area and duplicated. Those in the Variety Trial were grouped so that a comparison could be made between the later maturing varieties "Yandilla King" and "Nabawa" and also between the early maturing varieties as shown in the table of results. Superphosphate was applied in the Variety Trial at the rate of 112lbs. per acre.

In the Rate of Superphosphate Trial three rates were employed, viz., 150, 75 and 225lbs. per acre respectively. For these plots the variety "Nabawa" was selected.

In both experiments the rate of seed was 45lbs. per acre.

The following table shows the rainfalls as recorded at Pingrup during the year :—

	Useful Rains.											Total for Year	
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Total	Nov.	Dec.
1930	...	13	297	103	186	367	308	81	128	36	1,106	6	53
Average, 5 years	26	15	173	90	172	236	252	112	161	111	1,077	95	23

Although the totals for both the growing period and for the whole year are above the average, the rainfall for 1930 might well be deemed unsatisfactory. The rainfalls for the months of August, September and October were all below the respective averages, the total for these three months being only 245 points against the average of 417 points.

The results from both experiments are shown hereunder:—

#### WHEAT VARIETY TRIAL.

Rate of Seed 45lbs. per acre. Rate of 22 per cent. Superphosphate—112lbs. per acre.  
Planted 9th May, 1930.

Variety.	Maturity.	Computed Yields per Acre.		Average Yields per acre.	Percentage Yields per acre.
		Section 1.	Section 2.		
Yandilla King ...	Late ...	bus. lbs. 14 48	bus. lbs. 15 6	bus. lbs. 14 57	per cent. 78
Nabawa ...	Mid-season ...	15 26	15 38	15 32	82
Glyas Early ...	Early ...	17 56	20 10	19 3	100
Merredin ...	Early ...	18 4	18 24	18 14	96
Carrabin ...	Early ...	16 12	20 26	18 19	96
S.H.J. ...	Early ...	15 22	16 38	16 0	84

#### RATE OF SUPERPHOSPHATE EXPERIMENT.

Variety—Nabawa.

Rate of Seed—45lbs. per acre.

Planted 10th May, 1930.

Variety.	Computed Yields per Acre.		Average Yields per acre.	Percentage Yields per acre.
	Section 1.	Section 2.		
150 lbs., 22 per cent. Superphosphate*	bus. lbs. 18 52	bus. lbs. 18 18	bus. lbs. 18 35	per cent. 111
75 .. (Control) ...	17 ...	16 36	16 48	100
225 ..	18 42	18 24	18 33	111

The results from the Variety Trial indicate that during a season of scanty finishing rains such as was experienced in Pingrup during 1930, the early maturing varieties are more satisfactory on heavy land than are the later maturing varieties. Although a late maturing variety when given satisfactory climatic conditions would probably produce the heaviest yield, it is from the midseason and early varieties that we must expect the best results during a year of average rainfall.

In the Pingrup district it would probably be better to reserve the late maturing variety, "Yandilla King," for the light land and plant earlier maturing varieties on the heavy land. Of the early maturing varieties "Glyas Early" would probably give the most consistent yields.

As in previous years the results of the Superphosphate Trial indicate that the yields are increased by applying quantities of fertiliser in excess of 75lbs. per acre.

## WINE-MAKING FOR DOMESTIC PURPOSES.

H. K. JOHNS, Viticulturist.

This is a short account of methods of wine-making suitable for suburban householders in whose gardens there are often a few trellised vines laden with grapes, a large portion of which are allowed to go to waste. No attempt is here made to explain in detail all the methods and appliances necessary for preparing and making wines on a commercial scale. Only the fundamental processes and principles are discussed with enough detail to enable anybody to process small quantities for domestic use.

I would like to point out that wine for commercial sale purposes must comply with the Food and Drug Regulations, and under these regulations "wine" is defined as being the product solely of the alcoholic fermentation of the juice or must of grapes. The addition of water, sugar of all kinds, glycerine, artificial sweetening substances and colouring matters is prohibited.

One case of grapes will yield approximately three gallons, which can be made with little trouble.

Absolute cleanliness in all vessels in which the grapes are handled and their juice is stored are the main factors of success during and after fermentation.

Only good sound ripe grapes, carefully gathered, should be used. Good wine cannot be expected from unsound grapes affected by diseases such as oidium or black spot, or damaged by insects or birds. Grapes which from any cause are mouldy are undesirable.

After the grapes have been collected, they should be stemmed and the stalk of the bunch discarded. The berries should then be pulped by passing between rollers or by some similar method; small quantities can be mashed by hand or with a perfectly tasteless stick of wood. Care must be taken, however, not to crush the seeds. The crushed marc is then put into a vessel for fermentation to take place. An up-ended cask or keg with the top head removed is convenient, or earthenware open-top pickling jars in sizes from one to ten gallons. Metal, galvanised or tin vessels must not be used, as the tin coating soon disappears by its being attacked by the acids in the wine. The vessel in which ferment takes place should be filled to within six inches of the top. The crushed skins will rise to the top and form a layer or head, which is very liable to acetification, and to prevent this the layer should be submerged at least three times a day, either with the hand or a wooden rammer, thus thoroughly mixing the juice with the floating skins. The fermenting vessels should be kept covered with a clean cloth or hessian.

The length of time the crushed grapes should be allowed to ferment varies approximately from four to six days or longer. The longer the marc is allowed to ferment, the darker will be the colour of the resulting wine and the longer it will take to mature.

### *Separation of the Juice.*

A considerable portion of juice will run off after fermentation if the crushed grapes are transferred to a drainage cage, or if the vessel in which the ferment has taken place has a tap inserted near the bottom, which will drain and leave only the pulp, seeds and skins. These should then be pressed, and to obtain the best results the pressing should be slow and gradual. If no press is available, a good deal of the liquid can be obtained by squeezing by hand through a piece of hessian. Care

must be taken to remove by straining all seeds and particles of floaters, such as skins and pulp. The juice is then put into storage containers, the size and type of which will depend entirely upon the quantity made. With dry wines it is absolutely essential to have all containers filled right up. If wood storage is used a certain amount of evaporation takes place, which in time creates "ullage," and the containers must therefore be "filled" or "topped up" at least three times a month with a sound similar wine. Do not on any account use a fruity or sweet wine in topping up dry wines. This would tend to cause a secondary ferment.

Containers required to make up to from 10 to 30 gallons.--It would be advisable to have five and ten-gallon kegs, together with some one and two-gallon earthenware jars, demijohn type, so as to enable the using up of surplus wine from "filling up" and to prevent any ullages; small balance to be put in bottles.

To make 10 gallons or under, the wine should all be stored in one and two-gallon jars, together with a few half-gallon flagons.

When storage containers are first filled the liquid will still be fermenting, therefore care must be taken not to bung or cork tightly any one of them until fermentation has ceased. Each vessel should be covered with a clean piece of cloth weighted down with a small flat stone or bung to keep the same in position and allow the carbonic acid gas to escape. In small containers, such as gallon jars or flagons, cork the neck of the bottle with cotton wool. Containers should be stored in a cool place, and not moved or shaken up; in a short period fermentation will have ceased. The method adopted by the amateur to ascertain if this is so is to lower a lighted match slowly through the neck of the jar or bung-hole of cask. If the match is immediately extinguished, carbonic acid gas is present, which is an indication that fermentation still exists; if the match burns brightly, the wine is ready for racking or decanting into clean containers.

#### *Racking.*

Racking or decanting is necessary in order to separate the wine from its lees, and the first racking is the most important. Care should be taken that the wine runs off clear from the sediment (lees). If kegs are used, a small syphon hose is the best means of drawing off the clear wine. This procedure, racking, should be carried out at least three times in the first six months, and the wine should be in a good clear condition.

After racking, the containers should be corked or securely bunged and stored in a cool place; bottles to be laid on their sides.

## **BEE-KEEPING NOTES.**

### **METHODS AND TRANSFERRING.**

H. WILLOUGHBY LANCE,

Apiculturist.

On this occasion I propose writing a few notes on my observations whilst on inspection work. As might be expected, I find a great deal of difference in the apparatus and methods of Bee-keepers.

Dealing with apparatus first, I still find quite a number of box hives in some districts which necessitate my giving the owners notice under Section 12 of the Bees Act, to transfer these to hives in which all combs are removable for inspection; the penalty for non-compliance being £20. Then there is the man

that has standard frames and hives, but has neglected to put wire and foundation into the frames, and his expenditure on frames is worse than useless, as the bees have built cross comb, and not one of the frames can be removed. Some men have fitted starters or even full sheets of foundation, but due to the frames not hanging plumb in a level hive, or to the hereditary tendency of many bees to build irregular comb, the expenditure and labour are useless.

Another type of hive that one meets is the home-made one with incorrect bee spacing due to the ignorance of the owner of the habits and methods of bees. In some of these hives the covers or frames are stuck so tight with propolis that they break before they can be removed, or there is so much unnecessary space that there is a extra comb which has to be broken or cut before the cover or frames can be removed. All these cases are liable to a penalty not exceeding £20.

Bee-keepers should remember that the natural working space of the bee is  $\frac{1}{4}$  inch. If the space is less than  $\frac{3}{16}$ th of an inch the bees will fill it up. If it is more than  $\frac{5}{16}$ th of an inch they will probably build comb therein.

In a previous issue of this "Journal" I wrote an article on "Bee Hives;" this has been reprinted in leaflet form and can be obtained free on application to the Department of Agriculture. The article contains particulars and sketches of a home-made hive, including a cover or roof, which is much more serviceable and cheaper than most of those that I see on my travels.

Then the bees themselves--what a difference one finds: Any poultry keeper knows the difference between the hen that lays 15 or 20 eggs and then wants to sit, and the hen which lays all through the season without intermission, yet many men are quite content to have bees that gather a little honey and then swarm; gather a little more honey, then swarm again and so on three or four times during the season, at the end of which there is little more than enough honey for the bees to winter on; whereas for the expenditure of from 7s. 6d. to 21s. he could obtain a good queen from a non-swarming strain and obtain a crop of honey which would more than repay the expenditure on the queen.

A word here about Carniolans. So far experience shows them to be very quiet to handle, good comb builders, and excellent honey gatherers. The first cross of a Carniolan queen with an Italian drone so far showing about as good from the honey point of view when the drone comes from good stock, but generally they do not appear quite so quiet as the pure Carniolan.

As regards management, there are still a number of bee-keepers who stick to 8-frame hives and place a queen excluder on top and a box of sections or shallow frames over. This method induces swarming and small honey crops. A bee-keeper's first object should be to obtain strong hives, boiling over with bees, and not restrict the brood chamber. If the queen is prolific enough to fill two 10-frame brood boxes let her, then, given a good honey flow following, the bees will fill two full depth super boxes on top with honey.

A word with regard to the adding of a second super for honey. As soon as the bees have partially capped the centre three or four frames, the super should be raised and the extra super placed between it and the brood chamber, not on top of the first. It should be remembered that bees fill the top cells with honey first and work downwards. Do not wait until the first super is full before adding the second; make the bees realise that there is plenty of work for them to do and they will work all the harder.



Many small bee-keepers without much experience find it difficult to transfer bees from box hives to frame hives, or from frame hives with a mass of cross combs to new frame hives. For their benefit, I will give hereunder particulars of how best to do this.

The transfer should take place, if possible, while there is honey coming in, but it may be done at any time provided the bees are fed plentifully after the transfer has taken place, with sugar or honey syrup. The easiest way of feeding is to obtain a press top tin, such as is used for honey or golden syrup. Punch a dozen or two small holes in the lid and fill with the syrup.

A quilt made of ticking, sacking, or similar material should be placed over the frames and a hole cut in the centre not larger than the size of the tin. The tin of syrup may now be inverted over the hole; the bees will then suck the syrup through the holes. An empty super or box should then be placed on top to cover the tin and the cover of the hive replaced. At least eight or 10 lbs. of syrup should be given to each hive to enable the bees to build the new combs and lay up a store for breeding.

A syrup may be made for this purpose from sugar, using 10 lbs. sugar, 5 pints water, 1 oz. vinegar, 1 oz. salt. Boil for a few minutes and feed to the bees whilst warm. To make honey syrup, dissolve about 2 parts of honey in 1 part of water. If honey is used, the bee-keeper should be quite certain that this does not come from a hive that may have disease, as honey is the principal carrier of foul brood.

To transfer bees from old box to new hive, take the box hive and place on the ground upside down so that the bottoms of the combs are exposed, place bricks or blocks of wood under one end of box to give a slope; place new hive, fitted with frames and full sheets of foundation, on an empty box so that front edge of floor touches the highest end of box hive; draw body of new hive forward to project over floor about  $1\frac{1}{2}$  inches.

Drum sides of box and give a little smoke at lowest end. Bees will then run up highest end of box on to floor of new hive. When nearly all the bees are out the combs of honey can be cut out, some of which should be fed back to the bees after they are in their new hive; the combs of brood should be tied with string into frames and put into centre of new hive.

To transfer bees from hive with cross combs.—The method adopted may be similar to that with box hives, but in this case it will be impossible to cut out the combs of brood, and tie into frames. It should therefore not be adopted unless the hive is very strong with bees and there is a good honey flow.

Another method which may be adopted with both box hives and hives with cross combs, when the above are not suitable or easy, is to place the box or old frame hive on top of a new hive fitted with frames and full sheets of foundation, making sure that the only entrance is through the new hive.

As the brood in the old hive hatches out and honey comes in, the bees will fill the empty cells with honey and force the queen down into the new hive. When upon examination it is found that the queen is in the bottom, or new hive, a queen excluder should be placed over it to prevent her again going to the top box. Four weeks later all brood in the top box will be hatched out, and it may then be removed.

The drawback with this method is the time it takes, as the queen will not be forced down until there is plenty of honey coming in.

## TESTS WITH FODDER PLANTS, 1931.

### AVONDALE STATE FARM.

A. S. WILD, B.Sc. (Agric.), Agricultural Adviser.

These test rows were planted for the purpose of observing the growth and progress of the various plants under test. The land selected was typical York Gum and Jam country and had been fallowed during August, 1929. Each row was 100 links in length.

The fodders were all planted on the 1st May, superphosphate being applied to the equivalent of 150lbs. per acre.

The monthly rainfalls as recorded at the Farm through the year were as hereunder:—

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	
1930	...	...	5	62	153	44	554	619	258	81	35	...	95	1,906

### KIKUYA GRASS.

Roots of this grass were planted, but they failed to strike and consequently were a failure.

### NEW ZEALAND LUPINS.

These germinated on the 24th May the germination being 80 per cent., and flowered about the 21st September. The New Zealand lupins were not very successful, the plants failing to make healthy and vigorous growth. The maximum height attained was only about 12 inches. Probably the excessively wet condition and the nature of the soil (heavy land) were responsible for this failure.

### COMMON BLUE LUPINS.

This variety germinated about the 28th May, the germination being 25 per cent. By the 21st of September they were in flower but the plants had made very poor growth and lacked a healthy green colour, being somewhat yellowed. As with the New Zealand lupins, excessive moisture was probably responsible for this. The plants were still green towards the end of November when the New Zealand variety had completely dried off. The maximum height of the plants, however, was only 15 inches and very few seeds were formed.

### TANGIER PEAS.

Germination occurred about 23rd May, the germination being about 66 per cent. Throughout the season they continued to make good healthy vigorous growth. The plants continued green up to the middle of November when they commenced to dry off. A fair number of seed pods were formed, but these were attacked by insects.

### SUBTERRANEAN CLOVER VARIETIES.

The germination of the Dwalganup, Daliak, and Boyanup varieties was, in each case, fair, but that of the late variety, Wenigup, was poor. The plants of the last named variety, however, made comparatively good, healthy growth, the foliage being large and succulent.

The mid-season variety. Boyanup, made fair growth, being decidedly better than the Daliak variety and probably better than the Dwalganup variety.

The Dwalganup (very early) variety also made fair growth. This strain appeared to make stem rather than leaf growth but produced a fair amount of burr.

#### DROOPING FLOWER CLOVER.

The germination of this clover was poor. The plants made healthy growth but were small up to the end of September. Subsequently, however, they developed well and produced abundant flower and seed.

#### CLUSTER CLOVER.

This clover made slightly better growth than did the Drooping Flower Clover early in the season, but nevertheless the plants were small. Later in the season it progressed well, but was slightly inferior to the Drooping Flower Clover.

#### PHALARIS MINOR.

Throughout the season this grass continued to make good growth. It produced a reasonable bulk of feed by about September, the height of the plants being about 30 inches. The plants retained their succulence until the middle of November.

#### NEW ZEALAND LUCERNE (MARLBOROUGH STRAIN).

The germination of this seed was poor. It made healthy early growth but failed to provide any bulk of feed after extremely wet conditions set in. However it proved better than the Hunter River Lucerne.

#### HUNTER RIVER LUCERNE.

The progress of this variety was similar to that of the New Zealand lucerne, but the growth was slightly inferior. At the end of February, 1931, the plants of both varieties, although sickly, were still green.

#### SHEEP'S BURNET.

This made very slow growth but maintained an excellent colour throughout the growing season. The plants were about 2½ inches high, but at the end of February, 1931, were still green. This appears to be a promising fodder plant to provide late spring and summer feed.

#### WALLABY GRASS.

Germination of the seed of this grass occurred on the 1st June and was fair. Although healthy, the plants were comparatively small, being inferior to those of the previous year.

#### VELDT GRASS.

The Veldt grass made strong healthy growth, growing to a height of approximately two feet. It was still partially green late in February, 1931, and had produced abundant seed. This grass has demonstrated itself as suitable for both the lighter and the heavier types of soils in the Beverley District.

#### ANNUAL RYE GRASSES.

Wimmera Rye Grass (McDougall strain).

Wimmera Rye Grass (Common strain).

Italian Rye Grass.

All varieties germinated well and made excellent growth. The McDougall strain of Wimmera Rye Grass was probably the best, the growth of the common strain being about equal to that of the Italian Rye Grass. The maturity of these grasses was in the order as set out above.

#### PERENNIAL RYE GRASS (IRISH STRAIN).

This also germinated well and made good growth. The plants were shorter than those of the annual rye grasses, but were finer and more tufty. The test of this grass indicates a good pasture plant.

## PLAGUE OF MICE.

### MENACE TO WHEAT-STACKS.

C. J. CRAIG.

### METHODS FOR DESTRUCTION.

There is every reason to view with concern reports from various stations along the Transcontinental railway line of the presence of mice in vast numbers. The various methods of combating the pest as practised in Victoria may prove serviceable in case of a similar plague occurring here. It may be mentioned that nearly the whole of Victoria was infested in 1917, and that ducks, turkeys and River Murray fish were not popular as food as they practically lived on mice.

Mice are capable of doing enormous damage. The destructive and expensive plague of that time in Victoria was due in a large measure to delay in taking steps to safeguard stacks of hay and wheat, with the result that millions of mice did damage that was estimated to exceed £200,000. At the wheat stacks at Lascelles 500,000 mice, weighing eight tons, were destroyed in four nights. That was typical of the extent of the plague in almost every wheat district. Mice were killed by the dray-load. Conditions this year are just as favourable for the spreading of the vermin. The surest and least expensive method to avoid a similar plague is to deal immediately with the pests wherever they are present in unusual numbers and to safeguard stacks of wheat and hay.

The adoption of a method for destroying the mice depends largely on where they are. If the food that they are attacking can be shut up or placed beyond their reach the mice can be poisoned with strychnine mixed with flour and placed in suitable vessels, such as saucers. In the open a kerosene-tin half-full of water, having the top cut off and sunk level with the ground makes a very effective trap, when placed where the mice are sheltering or congregating. In many cases such traps will be completely filled in a night. Where the mice are not so plentiful an attractive bait placed on the bottom of the tin (no water being left in the tin) will often catch great numbers. In hay or wheat stacks fumigation is most effective, provided that the stack is not too large.

In many instances, however, fumigation is impracticable, and the adoption of the double-fencing system is preferable. This system is simple and inexpensive, and is the one recommended by the Vermin Branch of the Agricultural Department. A double wall of plain or corrugated iron, about 3ft. in height, should be erected around the stacks and sunk in the ground for about 1ft. The walls should be between 2ft. and 3ft. apart. Ramps of rope or old bags should be placed on the inside of the inner wall, and the outside of the outer wall to enable the mice to

climb over the obstacles. In this way the mice trying to enter the stack for food or trying to leave it for water, enter the space between the two walls, in which they are trapped and may be destroyed.

When mice are plentiful in stacks they usually also infest country homesteads. They can be destroyed by the caustic soda method, or by feeding them poisoned pumpkin seeds, turnips, carrots, or parsnips, to which they are most partial. Mix a little arsenic in water in which caustic soda has been dissolved, and then thoroughly immerse the seeds or vegetables. Then place the poison baits in places frequented by the mice.

Another good method of protecting stacks with iron is as follows:—

Obtain a sufficient number of sheets of plain galvanised iron to surround the stack to be protected, the sheets to be 3ft., 22in. gauge, and bend the edge of the sheets at right angles 6in. from the edge, leaving a balance of flat iron of 2ft. 6in. A trench should be made around the stack about 6in. deep, and the iron should be stood in the trench, with the flange on the top outward from the stack. The sheets should have a lap of 2in. where they join, and a backing of quartering at the joints, the timber being driven into the earth. The iron should be secured to the quartering by screws, and a galvanised screw should be inserted in the horizontal part of the lap. At the corners the flange should be cut, the sheet placed between the remaining length of timber and bent as before described, and a piece of iron bolted on top of the separated flange at those points. When the iron is fixed in position replace the earth. Care should be taken that the iron is not broken when bags are being removed from the stack. A stick should be placed at the corners leaning outward over the iron so that when any mice in the stack go searching for water they will climb the sloping stick, jump over and be unable to get back.

## **“STINKWORT POISONING”—A FORM OF BRAXY-LIKE DISEASE.**

By H. W. BENNETT, M.V.Sc.

A disease of sheep has been experienced, not uncommonly, in Australia which has been associated with the presence of Stinkwort (*Imula graveolens*) in the flowering stage. The writer has seen no published description of the condition, and the relationship of Stinkwort to the mortalities reported has not been defined. Many stockowners are strongly of the opinion that the deaths are due to the ingestion of this plant.

This condition, in Western Australia, was first reported and investigated in 1929. During this current year further outbreaks have been reported from several localities in the South-Western portion of the State. As a result of investigation, the writer has shown that the losses occurring under the conditions indicated are actually due to braxy-like disease.

Bulletin (1) has described a disease affecting sheep in South Australia which appears to be identical with the braxy-like disease occurring in Western Australia. The writer consulted officers of the Stock Department in South Australia in which State deaths in sheep are often ascribed by stockowners to poisoning by Stinkwort. From information supplied, the opinion is reached that the so-called Stinkwort

poisoning, as seen in South Australia, is probably due to braxy-like disease also. The fact that feeding tests carried out there have failed to demonstrate any toxicity in the plant may be taken as supporting this opinion.

It is proposed to describe the disease as it is found in Western Australia, the description being based on the investigation of two outbreaks which are referred to below.

### 1.—HISTORY.

(I.) *1929 Outbreak.*—On one property at Kojonup, 47 out of 400 merino weaners died during the period April 23rd to May 12th. They were running on a stubble paddock in which there was a liberal growth of Stinkwort in the flowering stage. The sheep were in only fair condition. Later in the year, no Stinkwort now being present, typical braxy-like disease appeared in a flock of merino ewes which were depastured on the same paddock.

(II.) *1931 Outbreak.*—On a property in the Beverley district 100 out of 800 merino lambs died within seven days from April 5th. The lambs were in forward condition, being almost ready for the market. They had been depastured for three or four weeks, prior to the advent of the trouble, on a paddock which was carrying a good growth of flowering Stinkwort. They had also, for short periods, had access to a paddock of wheat stubble which contained a good quantity of fallen grain.

On this property and on the one visited in 1929, it was apparent that sheep had eaten large quantities of Stinkwort flowers and fruits. In previous seasons this plant had been eaten by sheep without any detrimental effects being produced.

### 2.—SYMPTOMS.

The clinical appearances are typically those of braxy-like disease. The period between the onset of recognisable symptoms and death is very short. Sheep are usually found dead, generally in the morning. A number, however, have been observed while sick, and both types of symptoms described for braxy-like disease have been noted.

(I.) *Comatose or quiet type.*—The affected animal is restless and excited. It moves about chewing dirt, sticks, etc. The gait is staggering and “knuckling over” is observed. Within a short time the animal lies down, usually with its head turned round to the flank. Breathing becomes shallow and rapid. Frothing at the mouth and grinding of teeth are commonly noted. Loss of consciousness soon occurs and the animal lies stretched out on its side and dies quietly, usually within four hours of being observed sick.

(II.) *Convulsive type.*—This differs from the above in that the affected animal shows more or less continuous “galloping” movements, associated with twitching of muscles, champing of jaws, rolling of eyeballs and, towards the end, marked head retraction (opisthotonos). The majority of animals affected with the disease show evidence of scouring and are somewhat tympanitic (“blow up”).

Sheep may linger for up to three days, but this is unusual. Occasionally these typical signs of braxy-like disease are preceded by symptoms which appear to be referable to inflammation of the bowels due to the injury inflicted by the hairs of Stinkwort fruits which have been swallowed. These sheep have a tucked-up appearance, are scouring, and have a tendency to wander somewhat aimlessly or to walk into fences, etc.

### 3.—POST MORTEM APPEARANCES.

Post mortem examinations were made on seven sheep (3 in 1929 and 4 in 1931) which had just died, or which were killed for investigation. The changes observed are identical with those seen in cases of braxy-like disease, viz., injection (inflammation) of bowels and mesentery, congestion of the kidneys, softness of the liver and distension of the gall bladder. There are small blood spots (petechiae) on the outside of the heart and large haemorrhages beneath the inner lining (sub-endocardial haemorrhages in the ventricles).

In all cases of "Stinkwort poisoning" investigated, an additional finding is the presence of hairs of the pappus of Stinkwort embedded in the inner lining of the fourth stomach and bowels. On opening up the bowels these hairs are sometimes seen to form a veritable feltwork, particularly in the small bowel.

Microscopic examination shows these barbed hairs penetrating the wall of the bowel to varying depths (sometimes almost through to the muscular coat). The injury caused by the hairs produces a degree of inflammation (catarrh of the mucous membrane, haemorrhages and cellular infiltration).

In some cases, notably the Kojonup ones, local bacterial infection had been introduced as a result of the wounds created by the hairs.

The microscopic appearance of the liver and kidney were identical with those seen in braxy-like disease.

### 4.—CAUSE.

The disease is actually braxy-like disease. This disease has been shown by the writer\* to be due to active growth of a soil germ, the "B.L.D. bacillus" (closely allied to *B. welchii*) in the small bowel contents. The organism produces a potent poison, or toxin, in this medium and a condition of toxæmia results from the absorption of toxin from the small bowel. The "B.L.D. bacillus" can only grow actively in the small bowel contents under certain favourable circumstances which it is not necessary to consider here. Braxy-like disease, with the exception of occasional losses which occur on peas, is usually confined to the period during which green feed is available to the sheep. The disease, however, may occur when sheep are on dry feed, including flowering Stinkwort. The fruits ("seeds") of the plant, which develop very soon after it comes into flower, are the cause of the trouble. The injury occasioned by the barbed hairs of the pappus (the feathery attachment to the fruit) provides conditions which enable the "B.L.D. bacillus" to proliferate in the small bowel contents (there does not seem to be any active invasion of the bowel itself by this bacillus).

Stinkwort, then, is a factor which under certain circumstances may induce braxy-like disease; and, in the writer's opinion, in this State at any rate, it is otherwise harmless to stock.

In all seven cases of the disease investigated in the two outbreaks referred to, it was found that there was a great proliferation of the "B.L.D. bacillus" in the contents of the small bowel. In two cases the numbers of these germs present were estimated by direct microscopic count to be 700 million and 100 million per c.c. (the total contents of the small bowel about 150 c.c.). In one of the 1931 cases, which was killed whilst affected with the "convulsive" type of the disease, it

\* A full account of braxy-like disease of Western Australia is being published in the Journal of the Council for Scientific and Industrial Research.

was shown that the bowel contents (sterile filtrate) contained the highly potent toxin elaborated by the "B.L.D. bacillus," the absorption of which is the cause of the symptoms noted and death.

The idea of a plant paving the way for a bacterial disease is not a new one. Seddon (3) has given a good example. The continued ingestion of bracken fern leads to an inflammation of the intestines which permits of the development of a fatal bacterial infection. It is fairly generally recognised that the normal bowel exerts a protective action which is to a great extent lost when the organ is injured. Ouchi (2), for example, has shown that certain disease-producing bacteria which are destroyed in their passage through a normal bowel are not so destroyed when the bowel wall has been injured by parasites or chemical irritants, and under these circumstances they may prove fatal to the animal.

Although sheep as a general rule may eat Stinkwort seeds with impunity, when the soil is infected with the "B.L.D. bacillus," and in the presence of certain factors not fully understood, braxy-like disease results.

Evidence at present available indicates, as one would expect from experience with the ordinary type of braxy-like disease, that sheep in good condition are those which are most likely to be affected when grazing on Stinkwort.

#### 5.—CONTROL.

Control measures other than the control of the weed itself, or the removal of sheep from paddocks where the plant is prevalent, do not suggest themselves. The period of danger is short, being practically confined to the months of April and May when the plant is flowering and seeding. Partial starvation may help to check losses.

#### 6.—CONCLUSIONS.

(I.) A disease is described which affects sheep as a result of feeding on Stinkwort in the fruiting stage.

(II.) This condition has been shown to be identical with braxy-like disease. The barbed hairs of the pappus attached to the fruits of Stinkwort injure the bowel wall and provide conditions which are favourable for the growth and toxin production of the causal organism—the "B.L.D. bacillus."

(III.) This form of braxy-like disease was first noticed in this State in 1929. It appears to have occurred in a number of localities during the current year.

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## FLAG SMUT OF WHEAT.

### VARIETY RESISTANCE TESTS, 1926 TO 1930.

E. J. LIMBOURN, Cereal Breeder.

Merredin Experiment Farm.

The Flag Smut Resistance Tests, conducted at the Merredin Experiment Farm, are carried out in a plot well isolated from the main cropping paddocks in order to minimise, as far as possible, the danger of spreading infection throughout the farm.

In 1930 one hundred seeds of each of the varieties were planted in rows which were 50 links in length and two links apart, the seed being planted half a link apart in the rows. In the previous seasons, however, only 50 seeds were planted in the rows.

*Infecting the seed.*—A quantity of infected leaves was finely minced in order to get the spores as free as possible. To infect the seed, 100 grains of each variety were mixed with two teaspoonsful of the minced infected leaves, and well shaken up. It was found that the spores adhered very well to the brush end of the grain, and also in the crease.

*Planting.*—Each row was opened out with a hoe, and a light sprinkling of superphosphate given before dropping the seed. The infected grain was then pressed into the ground with a pinch of the minced infected material, and, before covering in the grain, the row was sprinkled with additional infected material.

*Recording infection.*—Inspection of the rows was made during the growth of the plants, and any infected plant found, pulled up and destroyed as soon as noticed. At the same time a record was made of the number of such plants in the Field Book. A count was also made of the clean plants at the end of the season, and from these two records the percentage of infection was obtained.

In the accompanying tables the 128 varieties so far tested have been classified in three sections, viz.:—

Resistant—0 to 10 per cent. infection.

Susceptible—11 to 25 per cent. infection.

Very susceptible—over 25 per cent. infection.

For the purpose of this experiment, the susceptibility of a variety is its highest recorded infection during any season in which it may have been tested.

It has been found that varietal infection varies with the time of planting and seasonal conditions. Therefore, to obtain very definite information regarding the susceptibility of a variety, it would be necessary to test such variety over a number of years.

Owing to the necessity for isolation indicated above, the area available for this experiment is limited. The major portion of the plot is also taken up by the plantings of new crossbred types and pure line varieties that are under selection for resistance to the disease.

In order to obtain some indication of the resistance of as many varieties as possible, only such varieties as show fairly high resistance to the disease have so far been tested for more than one season.

Of those included in the resistant section, the following varieties have been tested for two or more years with consistent results:—Baroota Wonder Early, Bencubbin, Bunyip, Carrabin, Confederation, Dindiloa, Exquisite, Florence, Ford, Geeralying, Ghurka, Nabawa, Nolba, Queen Fan, Riverina, S.H.J., Tobys Tusk, Wandilla, and Yetna.

Both Ford and Queen Fan are reported to be fairly susceptible under field conditions, and it is thought that the strain under test may have been improved by constant selection at this farm. Seed from a farmer's crop of each variety infected by Flag Smut has been obtained, and will be tested alongside the Experiment Farm strain during the coming season.

Ten of the *resistant varieties* are crossbred types produced by the Western Australian Department of Agriculture, either at the Chapman or Merredin Experiment Farms. Six of these are obtainable as Pure Pedigree Seed, they are:—Bencubbin, Nabawa, Carrabin, S.H.J., Geeralying, Sutton; the other four varieties being:—Bowes, Dindiloa, Nolba, Yetna.

Baroota Wonder Early is also recommended for hay by the Department of Agriculture, and obtainable as pure pedigree seed.

The susceptible varieties distributed by the Department are now limited to the following four:—Gluyas Early, Merredin, Noongaar, Yandilla King.

These all have other useful characteristics that make it difficult to replace or altogether discard them, but their susceptibility should be considered where the ground to be planted has borne an infected plot in previous seasons.

With the widespread use of the variety Nabawa in this State, it is not surprising that few reports of severe loss from Flag Smut are received.

Still further use of resistant varieties will do much to control the spread of this disease, which in other States is considered a real danger to profitable wheat growing.

# FLAG SMUT RESISTANCE TEST, 1926 TO 1930.

*Result of Varietal Resistance Test as shown by the percentage of infection obtained.*

Variety.	Reg. No.	1926.	1927.	1928.	1930.	Average.	Highest Infection.	Variety.	Reg. No.	1926.	1927.	1928.	1930.	Average.	Highest Infection.
Alliance ...	1700	...	22	...	...	22	22	Gresley ...	1038	2	6	21	...	10	21
Aussie ...	1785	...	22	...	...	22	22	Gullen ...	1993	...	...	...	...	3	3
Bald Early ...	986	5	...	...	...	5	5	Hard Federation	958	10	...	...	...	10	10
Baldmin ...	1897	...	...	...	57	57	57	H.J.I. ...	1948	...	...	...	...	2	2
Baroota Wonder	1349	2	...	...	...	2	2	Hunter ...	1903	...	...	...	...	9	9
Early Baroota	859	0	0	1	...	0.3	1	Indian Pusa 4	1750	...	0	7	14	7	14
Wonder	...	...	...	...	...	...	...	1459	...	...	...	16	16	16	16
Bena ...	1614	21	...	...	...	21	21	Joffre ...	1875	...	...	...	9	9	9
Beneubbin ...	1987	...	2	2	...	2	3	Joffrette ...	1873	...	...	...	5	5	5
Bindu ...	1887	...	...	...	1	1	1	King's White...	1368	...	...	...	20	20	20
Binya ...	1789	...	24	...	...	24	24	Krithia ...	1706	...	...	...	15	15	15
Bobin ...	1726	...	10	...	...	10	10	Lawson ...	1602	...	...	...	1	1	1
Bomen ...	1506	...	...	...	4	4	4	Lilydale ...	1721	...	...	...	...	...	...
Boolaroo ...	1727	...	10	...	16	13	16	Mahratta ...	1708	...	28	...	...	28	28
Boonoo ...	1736	...	3	...	12	7	12	Major ...	1270	...	2	...	...	37	37
Bowes ...	1804	9	...	...	9	9	9	Maruora ...	1709	...	37	...	...	37	37
Bredbo ...	1775	...	...	32	20	32	20	Merredin ...	1440	23	25	...	...	24	25
Bruce ...	1790	...	27	...	27	27	27	Minster ...	834	6	...	...	31	19	31
Bunyip ...	421	0	0	0	2	0.5	2	Minyip ...	1746	...	17	...	...	17	17
Cadla ...	1728	...	52	...	52	52	52	Mogul ...	1703	26	...	...	...	26	26
Caliph ...	914	0	3	20	...	8	20	Nabawa ...	1432	0	...	0	1	0.5	1
Camberra ...	709	16	41	...	28	41	28	Nabob ...	1705	...	24	...	...	24	24
Canimbla ...	1821	...	10	...	42	26	42	Newman's Early	955	4	3	19	...	9	19
Capitol ...	1698	...	41	...	41	41	41	Niloc ...	1277	13	...	...	...	13	13
Carrabin ...	1437	0	1	3	1	3	1	Nizam ...	1635	6	...	...	29	17	29
Cargo ...	1788	...	20	...	20	20	20	Nolba ...	1800	0	0	0	1	0.25	1
Carwarp ...	1835	...	...	...	19	19	19	Noongaar ...	1789	6	3	27	...	12	27
Cedar ...	222	...	...	...	1	1	1	Nugget ...	1609	...	34	...	...	34	34
Cedric ...	1456	...	...	...	37	37	37	Nungarin ...	1435	...	12	...	...	12	12
Clarendon ...	1507	1	...	2	16	6	16	Ogilvie ...	1803	17	...	...	...	17	17
Collin ...	1900	...	...	...	5	5	5	Onurah ...	1741	...	29	...	...	29	29
Comeback ...	228	1	0	0	20	8	20	Parsee ...	1701	27	...	...	...	27	27
Confederation...	1696	1	0	7	7	4	7	Patrol ...	1463	...	...	17	...	17	17
Coral ...	1891	...	...	...	8	8	8	Perfection ...	1929	...	...	...	9	9	9
Cowhorth ...	1938	...	...	...	40	40	40	Queen Fan ...	1194	0	0	2	1	1	2
Currawa ...	522	...	...	...	27	27	27	Rajah ...	1710	1	2	4	11	5	11
Currump ...	1747	...	...	...	16	16	16	Rancee ...	1697	7	5	27	18	14	27
Dargum ...	1905	...	...	...	26	26	26	Red Rock ...	1906	...	...	...	0	0	0
Dindiloa ...	1438	...	...	0	0	0	0	Reward ...	1894	...	...	...	7	7	7
Dollar ...	1776	...	...	...	49	26	49	Riverina ...	1786	...	2	4	10	4	10
Dookie Delta	1744	...	5	...	34	20	34	Roseworthy ...	1190	4	...	...	...	4	4
Drof ...	1988	...	...	...	78	78	78	Rymer ...	1379	...	...	...	0	0	0
Duri ...	1774	...	8	...	27	18	27	Sepoy ...	1695	...	3	...	17	10	17
Early Bird ...	1773	...	13	...	13	13	13	S.H.J. ...	1445	0	3	0	5	2	5
Empire ...	1702	...	46	...	46	46	46	Sindhi ...	1901	...	...	...	0	0	0
Exquisite ...	1739	...	0	0	3	1	3	Sovereign ...	1704	...	3	...	...	3	3
Federation ...	460	6	27	...	16	27	...	Sterling ...	1712	30	...	...	30	30	30
Firbank ...	225	...	...	...	5	5	5	Stewart ...	1831	...	...	...	0	0	0
Firwhill ...	1907	...	...	...	5	5	5	Sunset ...	675	...	...	...	0	0	0
Florence ...	223	0	...	2	0	7	2	Sultan ...	1199	3	...	...	...	3	3
Ford ...	915	...	...	...	7	4	7	Sutton ...	2028	...	...	...	2	2	2
Fortune ...	911	6	...	...	6	6	6	Suvla ...	1699	...	17	...	17	17	17
Gallipoli ...	1636	3	12	...	67	27	67	Toby's Tusk ...	920	1	8	6	...	5	8
Geeralying ...	1442	0	...	0	0	0	0	Turvey ...	257	3	...	...	26	15	26
Gem ...	1451	13	...	...	13	13	13	Union ...	1777	...	34	...	...	34	34
Genoa ...	1511	...	...	4	42	23	42	Viceroy ...	1711	12	...	...	...	12	12
Ghurka ...	1713	4	5	9	10	7	10	Wandilla ...	1182	0	0	0	3	1	3
Glueclub (Vic.)	1754	...	12	...	12	12	12	Wannon ...	1637	11	...	...	...	11	11
Glueclub (W.A.)	1787	...	12	...	12	12	12	Waratah ...	1627	32	...	40	...	36	40
Gluyas Early...	159	47	61	66	72	61	72	Wardfr ...	1756	...	3	15	23	10	23
Gluyas Late ...	1337	10	...	...	10	10	10	Whillan ...	1841	...	...	...	39	39	39
Golden King ...	1429	...	10	14	...	12	14	X.B. ...	1947	...	...	...	40	40	40
Golden Return	1991	...	...	...	54	54	54	Yandilla ...	392	...	...	...	19	19	19
Goonoo ...	1904	...	...	...	21	21	21	Yandilla King...	226	0	0	20	...	7	20
								Yetna ...	1801	...	0	1	0	0.3	1

## FLAG SMUT RESISTANCE TESTS, 1926 TO 1930.

Varieties arranged according to their percentage of infection, taking the highest percentage of infection shown for any season during the tests :—

## RESISTANT VARIETIES.

Highest infection recorded being not more than 10 per cent.

	%		%		%		%
Dindiloa ...	0	Yetna ...	1	Sultan ...	3	Ford ...	7
Geerallying ...	0	Baroota Wonder ...	2	Wandilla ...	3	Reward ...	7
Red Rock ...	0	Bunyip ...	2	Bomen ...	4	Coral ...	8
Rymer ...	0	Florence ...	2	Lilydale ...	4	Toby's Tusk ...	8
Sindhi ...	0	F.B. ...	2	Roseworthy ...	4	Iowes ...	9
Stewart ...	0	Major ...	2	Bald Early ...	5	Hunter ...	9
Sunset ...	0	Queen Fan ...	2	Collin ...	5	Joffre ...	9
Early Baroota ...	0	Sutton ...	2	Elbank ...	5	Perfection ...	9
Wonder ...	1	Bencubbin ...	3	Elrwhill ...	5	Bobin ...	10
Bindu ...	1	Carrabin ...	3	Joffrette ...	5	Ghurka ...	10
Cedar ...	1	Exquisite ...	3	S.H.J. ...	5	Ghuys Late ...	10
Lawson ...	1	Gullen ...	3	Fortune ...	6	Hard Federation ...	10
Nabawa ...	1	Sovereign ...	3	Confederation ...	7	Riverina ...	10
Nolba ...	1						

## SUSCEPTIBLE VARIETIES.

Highest infection recorded being from 11 per cent. to 25 per cent.

	%		%		%		%
Rajah ...	11	Golden King ...	14	Suvla ...	17	Goonoo ...	21
Wannon ...	11	Inderet ...	14	Carwarp ...	19	Gresley ...	21
Boonoo ...	12	Boolaroo ...	16	Newman's Early ...	19	Alliance ...	22
Glueclub (Vic.) ...	12	Clarendon ...	16	Yandilla ...	19	Aussie ...	22
Glueclub (W.A.) ...	12	Currimp ...	16	Caliph ...	20	Krithia ...	22
Nungarin ...	12	Indian Pusa 4 ...	16	Cargo ...	20	Wardfir ...	23
Viceroy ...	12	Minyip ...	17	Comeback ...	20	Binya ...	24
Early Bird ...	13	Ogilvie ...	17	King's White ...	20	Nabob ...	24
Gem ...	13	Patriot ...	17	Yandilla King ...	20	Merredin ...	25
Niloe ...	13	Sepoy ...	17	Bena ...	21		

## VERY SUSCEPTIBLE VARIETIES.

Highest infection recorded being over 25 per cent.

	%		%		%		%
Dargum ...	26	Mahratta ...	28	Cedric ...	37	Genoa ...	42
Mogul ...	26	Nizam ...	29	Marmora ...	37	Empire ...	46
Turvey ...	26	Omrah ...	29	Whillan ...	39	Dollar ...	49
Bruce ...	27	Sterling ...	30	Cowhort ...	40	Cadla ...	52
Currawa ...	27	Minister ...	31	Waratah ...	40	Golden Return ...	54
Duri ...	27	Bredbo ...	32	N.B. ...	40	Baldm ...	57
Federation ...	27	Bookie Delta ...	34	Canberra ...	41	Gallipoli ...	67
Noongaar ...	27	Nugget ...	34	Capitol ...	41	Ghuys Early ...	72
Parsee ...	27	Undon ...	34	Carindulla ...	42	Droif ...	78
Rancee ...	27						

## ROYAL AGRICULTURAL SOCIETY—FODDER CROP COMPETITION.

G. K. BARON-HAY, Superintendent of Dairying.

In order to encourage the growing of summer fodders in the dairying districts of the State, the Royal Agricultural Society conducted a special Competition commencing during the Spring of 1930, dividing the State into three Zones, as follows :—

ZONE 1.—Country north of a line running from the coast due east through Dardanup to the Great Southern Railway.

ZONE 2.—A line from the southern boundary of Zone 1, due south through Boyup Brook to the coast. All country west of this line bounded by the coast to be in Zone 2.

ZONE 3.—Districts south of Zone 1 and east of the eastern boundary of Zone 2, embracing the Denmark district.

A First Prize was offered in each Zone—£5; and a Second Prize in each Zone—£3. In addition, a Special Prize of £5 was awarded the competitor who produced the highest yield per acre in any Zone, irrespective of other points.

Entries were judged on the following points :—

Yield	...	...	...	...	...	50 points.
Freedom from Weeds	...	...	...	...	...	15 ..
Cultivation	...	...	...	...	...	15 ..
Freedom from Disease	...	...	...	...	...	10 ..
Evenness of Growth	...	...	...	...	...	10 ..
Total	...	...	...	...	...	100

In order that various crops might compete, it was arranged that yields should be based on food value per acre, and crops were compared on the basis of their starch equivalent.

Eight entries were judged, although a number of other entries were received but at a later date withdrawn. Only one entry was received from Zone 2, the remainder being from Zone 1, all competitors in Zone 3 withdrawing from the Competition before judging was carried out.

The following table shows the result of the Competition :—

Competitor.	Yield.	Evenness of Growth.	Freedom from Weeds.	Cultivation.	Freedom from Disease.	Total points.
	50	10	15	15	10	100
ZONE 1.						
S. F. Russell, Serpentine ...	50	8	11½	14	10	93½
L. Pearson, Bonger ...	41½	10	13	13	10	87½
J. A. Hay, Wagerup ...	42	7	15	12	10	86
Fairbridge Farm School, Pinjarra ...	31	7	13	14	10	75
J. Smith, Wokalup ...	16	8	8	10	10	52
Do. ...	16	4	6	7	10	43
H. J. Mullins, Waroona ...	22½	5	...	2	10	39½
ZONE 2.						
Estate of O. P. Richardson (Only one entry)	7½	9	15	10	10	51½

The summer proved an exceptionally dry one, as is shown by the following rainfall figures for Pinjarra and Brunswick, practically no useful rain having fallen from the end of September, in the case of Pinjarra, and from November, in the case of Brunswick. The excellent yields set out in the table, therefore, were obtained with almost no rain after the crops were sown.

	1930.									1931.		
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Pinjarra ... ..	1.36	2.81	11.65	8.86	5.61	3.77	1.71	1.21	0.56	<i>Nil</i>	0.04	0.84
Brunswick ... ..	1.93	3.45	13.33	8.26	4.75	4.35	2.91	1.58	0.49	<i>Nil</i>	0.08	0.68

The winner, Mr. S. F. Russell, was the only competitor in the Competition who irrigated his crops, the crops in this instance consisting of maize ( $1\frac{1}{2}$  acres), Sudan Grass (1 acre), and lucerne ( $\frac{1}{2}$ -acre).

The second and third competitors relied on maize for their summer fodder crop, exceptionally high yields being obtained when the season is taken into consideration, Mr. L. Pearson's crop averaging 19 tons 7 cwt. 3 qrs. per acre, while that of Mr. J. A. Hay, Wagerup, averaged 19 tons 11 cwt. 2 qrs. per acre. Mr. Pearson's crop was planted on fallow, Mr. Hay's crop following potatoes.

Fairbridge Farm School, Pinjarra, also presented a fine crop of maize which averaged 14 tons per acre.

These results indicate that, provided an area is set aside and fallowed during the winter for the growing of summer crops to be planted the following spring, heavy and reliable yields may be obtained even in a most adverse season.

## PROCEDURE FOR THE RAPID ESTIMATION OF SOIL ALKALI AND SALT UNDER FIELD CONDITIONS.

By L. W. SAMUEL, Soils Officer, and L. J. H. TEAKLE, Plant Nutrition Officer.

### THE PROBLEM—INTRODUCTORY.

With the advance of our knowledge regarding soil conditions and plant growth, there has arisen an increasing demand for information to assist in the evaluation of soils for fertility and to assist in the solution of the soil problems with which farmers are faced. Throughout the civilised world Governments and Associations have established scientific institutions and stations for the study of their particular agricultural problems. With regard to soils, the problems of soil classification, soil acidity, soil alkali and manurial requirements and responses receive particular attention. The results from these institutions and stations have been so incorporated into the art of agriculture that one usually assumes them as a matter of course, forgetting the trials and patient labours of the numerous investigators who contributed their best to the solution of the problems.

The first task of the investigator following the preliminary definition of a problem is the devising of suitable methods for obtaining the information required

to answer the questions involved. Due consideration must be given to soil variability, and conclusions, to be reliable, must be based on a multitude of data, perhaps treated statistically for simplicity of presentation.

The problem facing the authors was a soil classification with particular regard to the presence of alkali and salt. An unfortunate occurrence of deleterious amounts of alkali in some soil types in certain outlying districts of the wheat belt of Western Australia has led to the institution of soil investigations in connection with land settlement. These investigations have involved the recognition of soil types and subtypes, and the examination of numerous samples representing these for alkali and salt content. A sufficient number of samples is taken to enable the results to be treated statistically, and the soil types are mapped and coloured, in accordance with the alkali or salt content.

Examination of the soils in the laboratory of the Government Analyst and Mineralogist has shown the soil alkali to approximate the composition of the salts in sea water (Teakle 1929). In general, in these saline soils about two-thirds of the alkali is common salt (sodium chloride). Little or no sodium carbonate or black alkali exists, but the normal soils all show an accumulation of calcium carbonate, usually in the form of nodules, in the subsoil. Some soil types are calcareous even at the surface.

This group of soil types belongs to the mallee zone of Australia (Prescott 1930).

#### THE METHODS USED.

The relatively constant composition of the alkali and its freedom from sodium carbonate enables the use of a conductivity method for the determination of total water soluble salts or alkali, with the electrometric method of chloride titration devised and described by Best (1929) as a control.

The conductimetric method adopted for this work is a modification of the American method described in detail by Davis and Bryan (1910). The portable Wheatstone bridge, admirably suited for field work, is used, but the conductivity cup with the soil paste is discarded. Instead a 1:2 or 1:5 soil suspension is used, the conductivity being determined by means of specially designed platinum electrodes coated with platinum black.

The soil samples as brought to the camp from the field in small calico bags are first sieved through a No. 10 wire mesh sieve to remove stones. Portion of each sample is placed in a moisture dish and dried at a temperature between 80°C. and 90°C. for at least four hours in a copper hot-air oven. More complete drying is considered unnecessary as the error due to moisture remaining in the soil after such treatment is very small, probably less than one per cent. of the determination. As moisture dishes, small dishes of first quality tinware two inches in diameter and nine-sixteenths of an inch deep were obtained from a local tinware firm, and numbered permanently by means of steel stamps. A Quirk's patent petrol burner serves to heat the hot air oven and gives a very steady heat, maintaining the oven temperature between 80°C. and 90°C. for hours at a stretch without attention and at low running cost. When five hundred samples were being analysed weekly the consumption of petrol was slightly more than one gallon per week.

From the moisture dishes the soil is weighed by means of a triple beam balance into 2-ounce wide-mouthed bottles. The requisite volume of rain water of very high resistance and negligible salt content is then run on the soil from a pair of semi-automatic burettes (Fig. 1A). The samples are analysed in batches up to 70 in number (the trays used holding just 70 bottles), so that the time taken for the

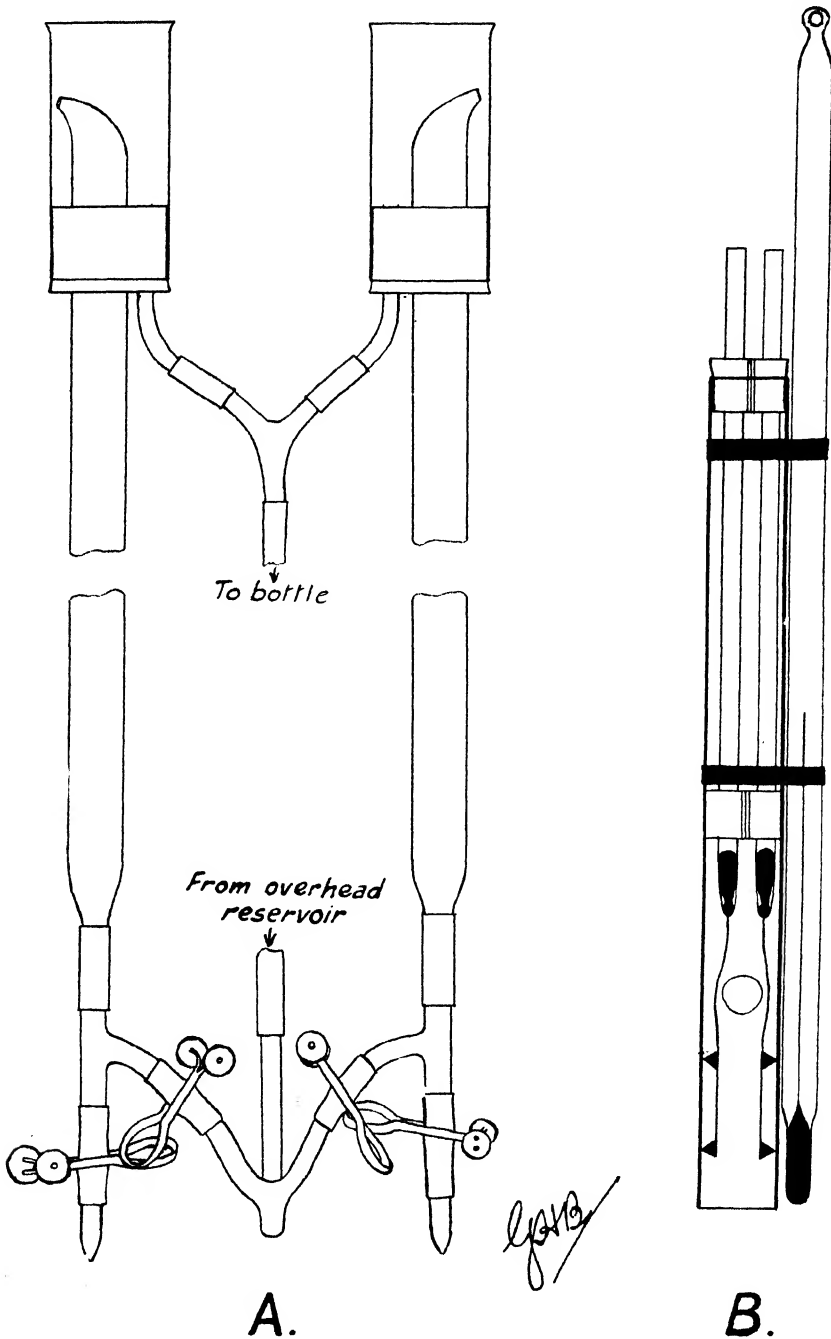


Fig. 1—A.—Diagrammatic representation of the automatic burettes suitable for field work on alkali investigations.

B.—Diagrammatic representation of the platinum electrodes and thermometer unit used in the field work on alkali investigations.



addition of water to them in consecutive order allows ample standing for the extraction of soluble salts. After all have been filled, the bottles are stoppered with numbered corks and well shaken. It is more convenient to number the corks and keep them consecutive than the bottles.

As a result of considerable experience, a 1:5 suspension has been adopted. The advantage of the 1:5 suspension (in our case 10 grams of soil to 50 mls. of water) is that all the soil is saturated merely by running the water on to it. Using a 1:2 suspension, as originally planned, saturation was not attained so readily, particularly in the case of clay soils, so that the full extraction effect during the period of standing before shaking is not obtained. The soil suspension is allowed to stand for 10 or 15 minutes after the first shaking and is then shaken again and its resistance determined by the Wheatstone bridge and the platinum electrodes. The temperature of the suspension is read at the same time to enable the observed resistance to be corrected for temperature. After each sample the electrodes are washed by dipping into rain water and excess water removed by touching the electrode vessel on blotting paper.

The above procedure was found to extract all the soluble salts, for no change of resistance or of chloride content was found even after a further 24 hours' standing.

To ensure the correct adjustment of the instruments the resistance of N/50 potassium chloride solution is determined before and after the reading of each batch of soil suspensions.

Following the determination of the resistance of the soil suspension, a number of samples are selected for titration of chloride ion by Best's method (1929). On the average 20 per cent. of the samples are analysed titrimetrically as well as conductimetrically. Suspension equivalent to 5 grams of dried soil is pipetted from the bottles in which the resistances were read into clean two-ounce bottles with numbered corks. The titration with N/35.5 silver nitrate solution, using a Philip Harris & Co. Ltd. Galvanometer No. 6025, is then made with considerable rapidity as the approximate amount of reagent required to react with the chloride in the soil suspension is known from the resistance value. The samples to be titrated are selected with a view to covering the range obtained in the batch, to checking readings not consistent with the soil type, and to obtaining accurate chloride contents of samples which the resistance values indicate to be on the border line for safe wheat growing.

### THE PLATINUM ELECTRODES.

Some special mention must be made of the platinum electrodes (Fig. 1B). These were designed to fit the 2oz. wide-mouthed bottles available. As suitable foil was not available, a piece of platinum wire was rolled to a thickness of about 0.1 mm. and from this two pieces, each 2cms. x 1 cm. in size, were cut. A short piece of fine platinum wire was then welded to the narrow end of each and each wire sealed into a narrow glass lead-in tube. The electrode vessel is a glass tube 6 inches long and  $\frac{1}{2}$  inch internal diameter with a hole 7 mm. in diameter 3 cm. from the lower end, to allow free exit of air and entry of solution. Slots in the supporting stoppers are liable to become clogged. Into this glass tube (the electrode vessel) were placed the electrodes, held rigid by passing the lead-in tubes through two two-hole rubber stoppers, the lower one of which fits tightly and completely inside the electrode vessel. Complete rigidity and security of the plates were obtained by bending back for about 1.5 mm. the four corners of each plate and sealing the points into the electrode vessel. The lower edge of each plate is

1 cm. above the bottom end of the glass tube and the top edges of the plates are level with the lower rim of the hole in the electrode vessel. The function of the space between the lower ends of the plates and the vessel itself is to keep the plates in the supernatant liquid and out of the soil at the bottom of the bottle and so avoid as far as possible the mechanical abrasion of the platinum black by the soil particles. In this connection the 1:5 suspension has the further advantage of having a smaller depth of soil in the bottom of the bottle.

The plates are cleaned by boiling first in caustic soda solution and then in diluted sulphuric acid. Following this treatment the electrodes are washed well with distilled water and then coated with platinum black by electrolysis in one per cent. aqueous platinum chloride acidified with hydrochloric acid. Using a 4-volt accumulator as a source of current and reversing the direction of the current every half minute a satisfactory deposit is obtained in half an hour.

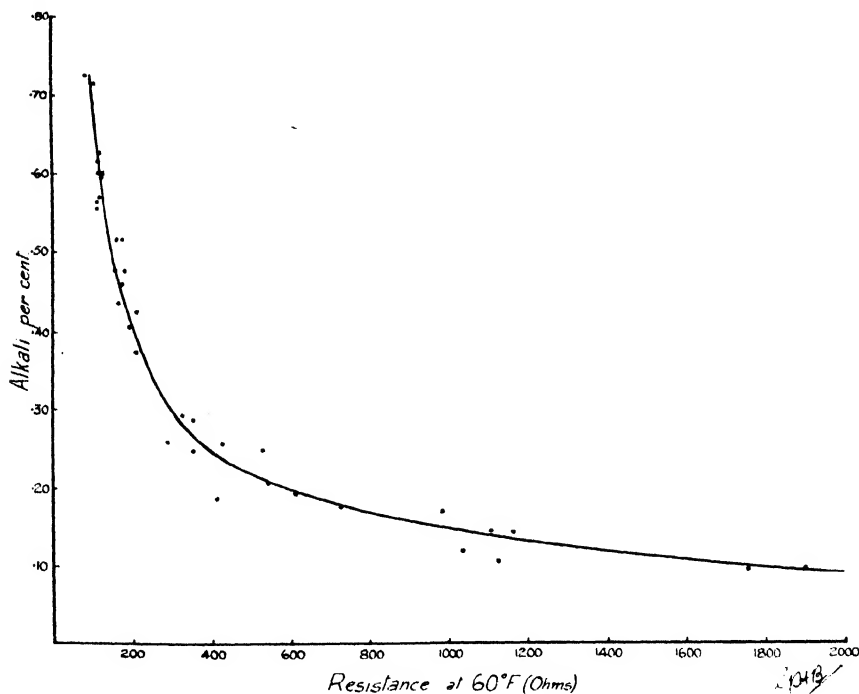


Fig. 2.—Graph for conversion of Resistance of 1:5 aqueous suspension of soil at 60°F. to percentage of alkali—showing the scatter of the points obtained.

In use, a thermometer is fixed to the side of the electrode vessel by rubber bands to facilitate the taking of the temperature of the suspension at the same time as the resistance is determined.

The electrodes are connected to the bridge by flexible leads to enable the electrode vessel to be moved from bottle to bottle.

A cell of the dimensions given above gives a reading of the order of 100 ohms at 60°F. for N/50 potassium chloride solution.

## THE RESULTS.

The results of the resistance determinations are corrected for temperature and converted into terms of alkali and salt by reference to standardisation graphs prepared for the area under investigation.

The standardisation graph for alkali or total water soluble salts is constructed by plotting the laboratory analyses of type samples for total water soluble salts using the 1:5 water extract against the resistances as determined by the Wheatstone bridge. A typical graph is illustrated in Fig. 2. As a rule the points on the water soluble salts : resistance graph scatter fairly widely about the mean curve, especially on the lower range of the curve. This is apparently due to the variations in the composition of soil alkali and to the fact that the proportion of com-

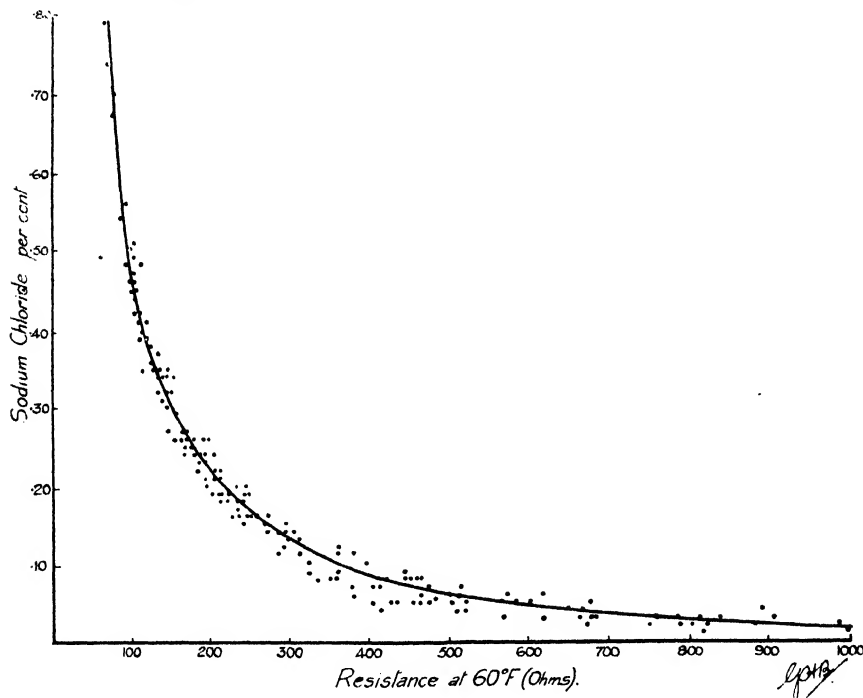


Fig. 3. —Graph for conversion of resistance of 1:5 aqueous suspension of soil at 60°F. to percentage of sodium chloride (salt)—showing the scatter of the points obtained.

mon salt to alkali decreases as the quantity of alkali in the soil is lowered. As the ionisation constants of the various salts and the transport numbers of the different ions vary greatly it is to be expected that variations in the composition of the alkali will affect the results.

The standardisation graph for salt is constructed from the resistance and the sodium chloride content (obtained from the chloride content) obtained by actual field demonstrations; such a graph is illustrated in Fig. 3. The points scatter much less widely than on the alkali graph, but the graph has to be revised for different districts, even in the same area. Fig. 4 illustrates the divergence of

the sodium chloride : resistance graphs which is obtained for adjacent districts in the same area; in this case Lake Newton (southern), and Lake Fox (northern). It is to be noted that the greatest discrepancy occurs in the soils of low sodium chloride content, the differences in the curves for more saline soils being more or less insignificant.

When the nature of the subject is considered and all the factors leading to soil heterogeneity are recognised, it is surprising that such remarkably good agreement is obtained no matter what the physical texture of the soil may be. It is rare to obtain values of sodium chloride by the resistance and titration methods which differ by more than 0.03 per cent. sodium chloride using the same sample.

In practice all results are expressed in terms of sodium chloride (calculated from the chloride content) as the sodium chloride graphs for different districts are obtained in the field. From the analyses of type samples for alkali or water

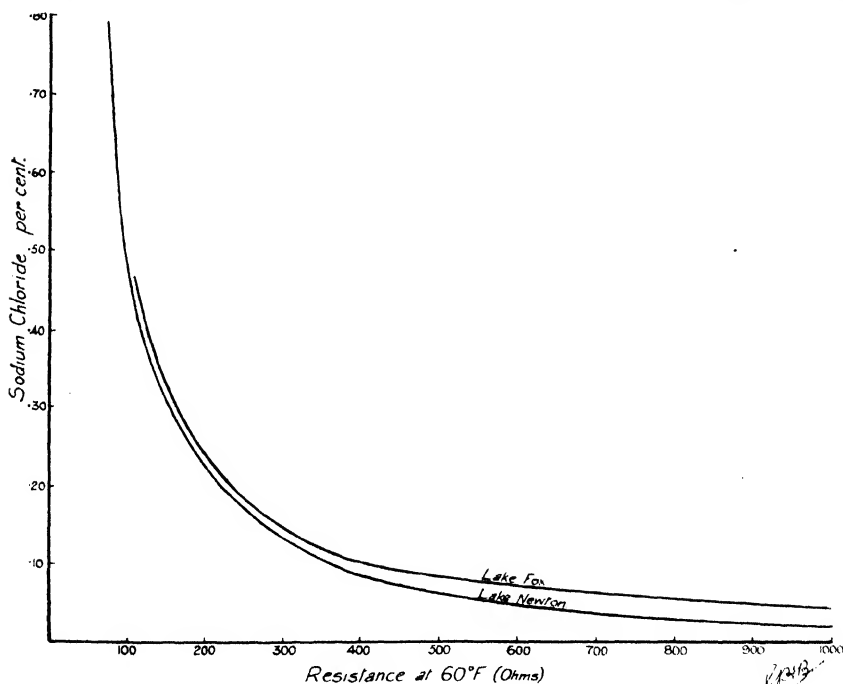


Fig. 4.—Graphs obtained for conversion of resistance of the soil suspension to percentage of sodium chloride (salt) in soils from two different districts in one area.

soluble salts, using a 1:5 water extract, a conversion graph has been constructed so that the results may be expressed both in terms of alkali and sodium chloride. The conversion graph (Fig. 5) illustrates there is a fairly direct and definite relation between alkali and sodium chloride in soils containing above 0.18 per cent. alkali. In the normal soils, those containing insignificant quantities of alkali, sodium chloride becomes an unimportant constituent of the soluble matter.

It is essential for a soil alkali survey that soil sampling be very thorough, so that the results may be treated statistically. This necessitates the accurate examination of large numbers of samples and the ordinary laboratory methods are

totally inadequate. The method must be very rapid and suitable for field practice: rapid enough to allow the examination of between 200 and 250 samples per day by a chemist and an assistant. The procedure described fulfils these requirements, and the necessary equipment is readily arranged in a 10ft. x 12ft. tent with conveniences made of boxes and a table top. The degree of accuracy is high, very much higher than that of sampling under ordinary field conditions. No tedious filtrations are needed and the difficulties of removing suspended matter are eliminated as the Wheatstone bridge is affected only by electrolytes. In fact, the resistance may be taken as the physiological index of the soil with respect to alkali. The maximum error to be expected is approximately 0.03 per cent. sodium chloride. For alkali the error is somewhat higher but, physiologically, is of the same order of magnitude.

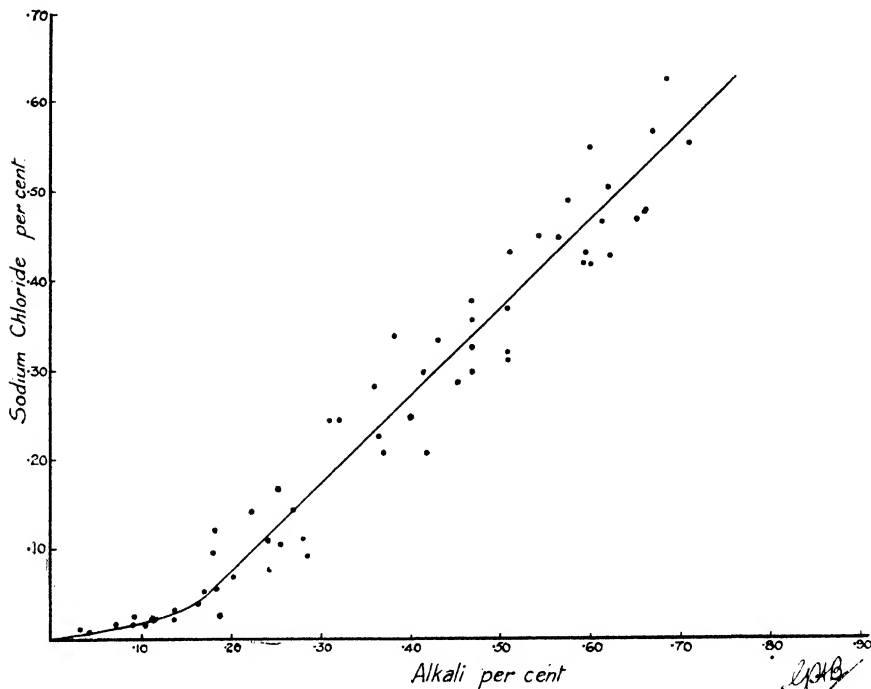


Fig. 5.—Graph for conversion of percentage of sodium chloride to percentage of alkali in soils using the conductivity method described. The dots show the scattering of the points through which the conversion curve is drawn and reflect the variations to be expected in individual samples.

#### SUMMARY.

A convenient procedure for the rapid examination of soils in the field for alkali and salt content is described.

The resistance of the 1:2 or 1:5 soil-water suspension is determined between platinum electrodes using a portable Wheatstone bridge and this converted to alkali and salt contents by means of standardisation graphs.

The results of the resistance determinations are checked by the titration of chloride in 20 per cent. of the samples, using Best's electrometric method.

Between 200 and 250 samples may be examined and checked per day by a chemist and an assistant using this procedure.

The authors wish to acknowledge the assistance of Mr. G. H. Burvill in the preparation of the manuscript, and particularly for the preparation of the figures for publication.

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## THE GERMINATION OF CRIMSON CLOVER SEED.

(*Trifolium incarnatum.*)

A. B. ADAMS, B.Sc.Agr.

Capt. R. H. Bell, of Balingup, reports that Crimson Clover does well as pasture on his farm the first year of sowing. Although the plants seed prolifically, there is practically no growth the second season from the self-sown seed; if, however, the seed is harvested and sown with the first rains, it gives good germination and a better pasture than is usually obtained from the first year of Subterranean Clover.

On carrying out germination tests with some of the saved seed, from 95 to 100 per cent. germinated within 48 hours. The few that did not germinate within that time germinated later. There were no hard-shelled seeds.

It is evident from this result that the reason that there is little or no growth from the self-sown seed is because the seed germinates so readily that a light shower, or possibly a heavy dew, will cause it to commence growth, only to die with succeeding hot, dry weather.

Crimson Clover probably had the habit of forming hard-shelled seeds when in the wild condition, but has been grown as a farm crop for such a long period that it forms these hard seeds only very exceptionally, if at all, as the usual practice of growing such crops for seed will encourage that type of plant that bears seeds that will germinate immediately they are sown, and discourages those plants that originate from hard-shelled seeds.

This absence of hard-shelled seeds is probably the real reason that Crimson Clover, a plant well suited to our soils and climate, is so little grown.

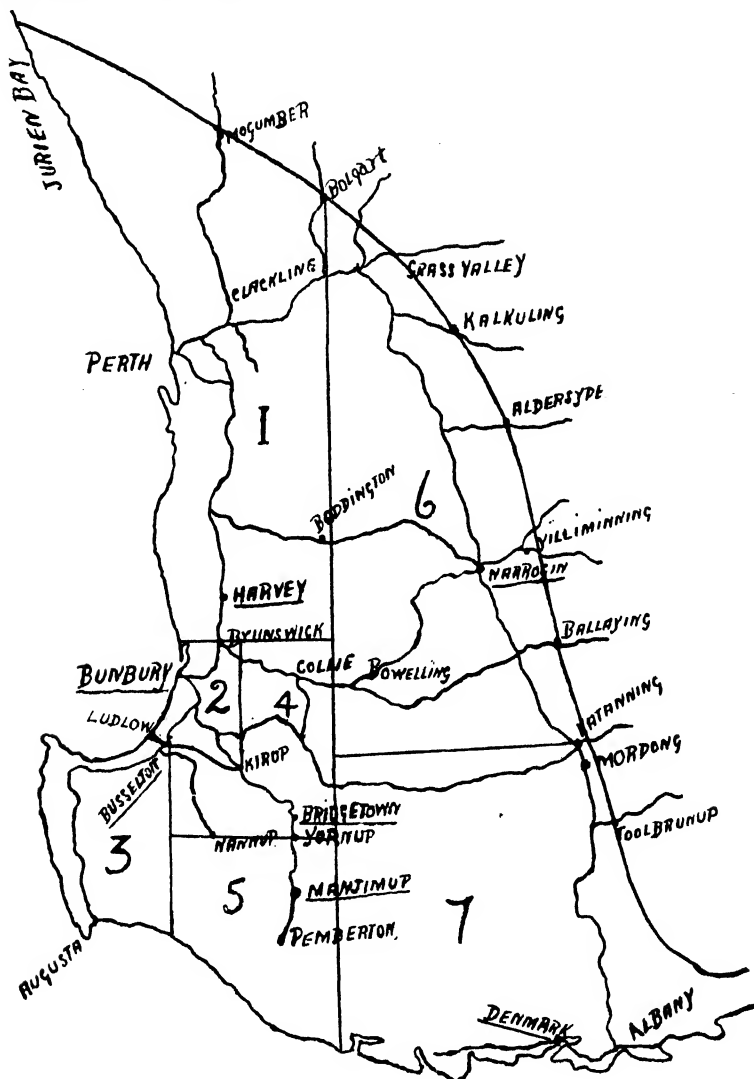
### BETTER DAIRYING COMPETITION.

With the object of encouraging increased butter production and improved methods of dairy farming, the Australian Dairy Council has made available a sum of money which is being utilised to conduct a "*Better Dairying Competition*."

For this purpose the Dairy Belt (*i.e.*, land west of the 20-inch rainfall line) has been divided into seven zones, with prizes as follows:—

First Prize in each Zone	....	....	....	£8 8s.
Second Prize in each Zone	....	....	....	£5 5s.
Third Prize in each Zone	....	....	....	£2 2s.

In addition a Champion Prize of £10 10s. has been awarded by Messrs. Cuming, Smith and Mt. Lyell Fertiliser Co., to be competed for by the First Prize winners in each zone.



Judging will be carried out by Officers of the Dairy Branch, Department of Agriculture.

Zone boundaries are shown on map, with the Agricultural Societies in charge underlined, as follows :—

- Zone 1.—Agricultural Society, Harvey.
- Zone 2.—Wellington Agricultural Society, Bunbury.
- Zone 3.—Agricultural Society, Busselton.
- Zone 4.—Agricultural Society, Bridgetown.
- Zone 5.—Agricultural Society, Manjimup.
- Zone 6.—Agricultural Society, Narrogin.
- Zone 7.—Agricultural Society, Denmark.

Entries should be made through the Agricultural Society in charge of each zone.

NO ENTRY FEE TO BE CHARGED.

ENTRIES CLOSE AUGUST 31st, 1931.

Judging will be carried out from November 1st, 1931, to January 31st, 1932. Entries to be judged on the following points :—

75 points	...	Farm Management.
100	..	Dairy Herd.
100	..	Pasture and Fodder Crops.
150	..	Fodder Conservation, particularly Silage.
25	..	Utilisation of Separated Milk for Poultry, Pigs, etc.
50	..	Butter Fat Production per acre.

All inquiries should be addressed to the Secretary of the Agricultural Society in charge of Zone.

## CARNIOLAN BEES.

H. WILLOUGHBY LANCE, Government Apiculturist.

A contributor, writing in "The Bee World" about different races of bees says— "Recently it has been found that another race possesses all the good qualities of both black and yellow, besides showing other very desirable features. 'Grey Carniolans' are as quiet upon the combs and even gentler than Italians. They are as hardy and as good workers as any blacks can be, but combs built by greys are snow white and clean, and in their hives there is always very little profolis, so that combs are readily removable.

"Of still greater importance for the beginner as well as for the professional is the fact that, by proper management, they can easily be induced to rear brood both in and out of season, so the very smallest nucleus will rapidly build up to a powerful colony. Therefore, grey Carniolans are the only bees for the commercial migratory beekeeper, wanting to obtain large honey crops in spring, summer and autumn."

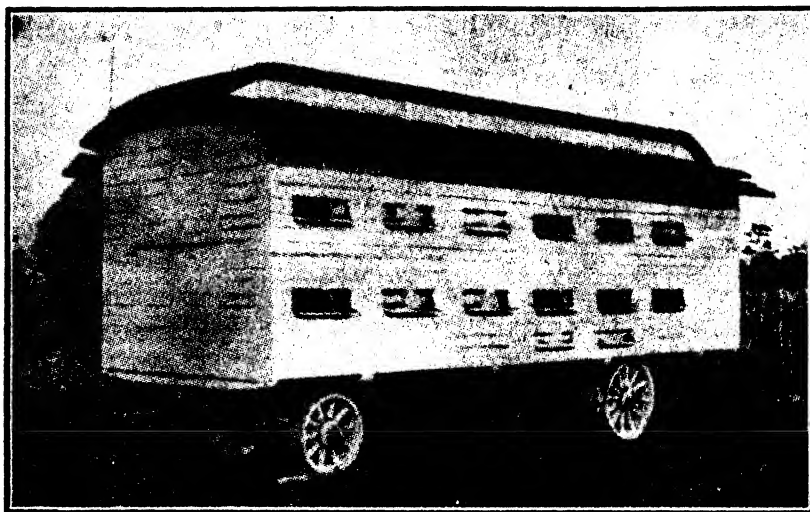
All that this correspondent says is confirmed by our experience in Western Australia. The verdict of those that have given them a trial is that they are the race best suited to our State. One large firm of commercial beekeepers that has tried all the available races of bees commenced with Carniolans about six years ago



and for two or three years carefully compared them with the other races, with the result that 80 per cent. of their bees are now Carniolan, or have the Carniolan strain on either the Queen or Drone's side.

Carni-Italian (Carni Queen and Italian Drone) or Italian-Carni (Italian Queen and Carniolan Drone) are found to be equal to Carniolan pure in most cases, but after the second or third generation they usually lose some of their most desirable characteristics. It is advisable, therefore, to introduce fresh pure stock at least every two years.

It is with the object of being able to supply pure stock that the Government have established a Carniolan Apiary at Rottnest Island. The Island is 12 miles from the mainland and as there are no other bees on the Island, there can be no



One of Hoehegger's movable house-apiaries on wheels, containing from 40 to 50 strong Carniolan colonies.

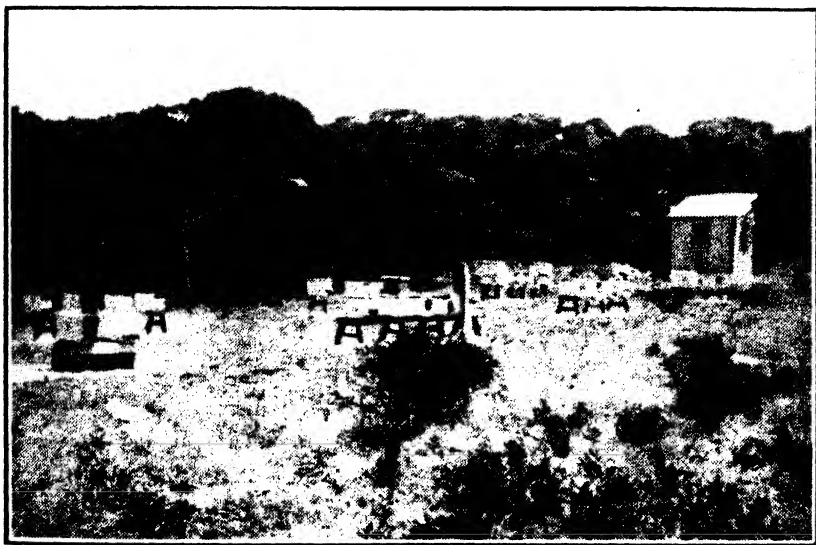
“The Bee World.”

doubt about the purity of the race being maintained. It is intended to import fresh breeding Queens each season direct from Carniolia, so that the stamina of the race may be maintained. Briefly summarised, the advantages of the “Grey” Carniolans are:—

- (1.) They are longer lived than Italians or Blacks, and as a consequence there is less brood in the hives for the same strength of colony.
- (2.) They produce more honey than the average Italian or Black, no doubt partly due to the fact that they require less brood to keep up the strength of the hives, and, therefore, consume less food in brood rearing. They also appear to have stronger wings than the other races, which would doubtless account for their longer life and better honey storing capacity, as they can work in wet and windy weather when Italians would stay at home. We recently sent a colony of Carni-Italians to the South-West and the purchaser was exceedingly pleased to find that they were working the Karri blossom all through the rain. As the Karri blossoms in the winter, this trait is a most important one for the honey producer of the South-West.

- (3.) They are very quiet to handle. During the honey season, one never need wear a veil, and very little smoke, if any, is required. Of course, when there is a dearth of honey or hives have been badly disturbed, the quietest colonies become somewhat pugnacious. I have opened hives under urgent circumstances half an hour before sunset and have almost been driven away from Italian colonies, but have had no difficulty with Carniolans.

In past years there has been a prejudice against Carniolans, as they were reported to be great swarmerers. This has not been borne out by recent experience in Australia. The prejudice was probably due to the fact that in the early days the importance of plenty of room in advance was not realised by beekeepers. It is generally recognised in these days that to obtain a good honey crop and to reduce swarming, the bees must have plenty of room in advance. The Carniolans, being rapid honey gatherers, probably caught many beekeepers napping, with the result "swarming." Mr. W. S. Pender, writing recently in the "Aus-



Bottleneck Apiary, 1931.

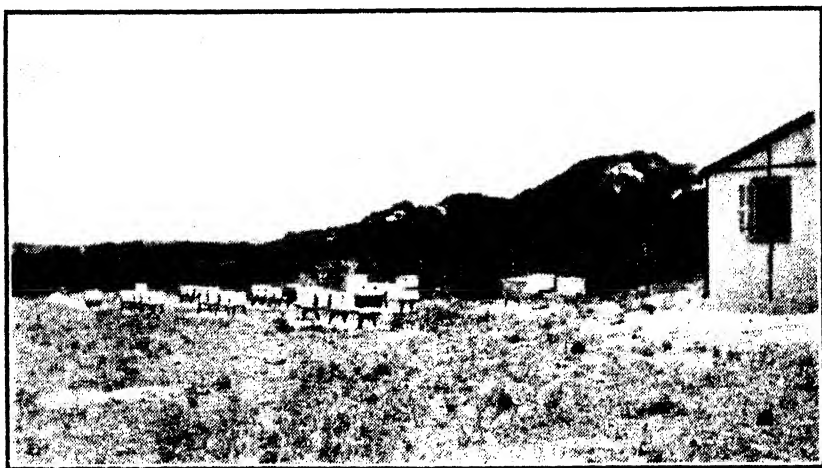
tralian Bee Keeper" says that he has been trying Carniolans for two seasons, and that he "gave these Carniolans every inducement to swarm, the hives being left over-full of honey, and had not had one swarm from them in his apiary of 30 colonies. The only two swarms he had were pure Italian."

Now I would not advise beekeepers to "give them every inducement to swarm," to test them as Mr. Pender did. I would say "give them plenty of room to store," so that you may obtain the full advantage of the honey crop.

In comparing the various races of bees, it should be remembered that the natural conditions of the native country of the race must have a great influence upon their physical structure and characteristics. If the race comes from a country where all is sunny and calm, and where there is plenty of nectar to be gathered without battling with severe weather conditions, one would not expect to find the race so hardy as those from a mountainous region where the conditions are hard,

the honey harvests small and gained under very great difficulties and over great distances, and where, in the past centuries, beekeepers did not help artificially to improve the conditions. In such countries, the law of the survival of the fittest operated, and a strong virile race of bees results, and this appears to be what has happened in Carniola. Why this selfsame race should at the same time be so quiet to handle is not so easily explained. It may be that, in their homeland, they have not so many enemies to fight against as in some other countries, and, therefore, are more trustful when carefully handled.

A paragraph in "The Bee World" gives an interesting fact:—"That the Austrian Empress Maria Theresia (1740-1780) appointed in 1770, the famous beekeeper of that time, Anton Jansa (pronounced Jansha) from Upper Carniola to come to the Court as an instructor for beekeeping for Vienna and Lower Austria. Jansa was there only three years, for he passed away in 1773; but in this short time he increased the productiveness of beekeeping amazingly by introducing Carniolan



Rottneist Apiary, 1931.

bees, and hives for migratory beekeeping, as the originator of which he is respected in Austria." The scientific name of these bees is "*Apis mellifica Norica*," signifying that these bees are found all over the districts of the old Roman province of Noricum and not only in Carniola, although at the present time the principal breeders are situated in Carniola, which has given them that name. Those bred in Carniola, however, appear to be more distinct, as some of the Noric bees tend towards the leather Italians.

The prices of Carniolan queens are as follow:—

	s.	d.
Carniolans, guaranteed pure selected	21	0
Carni-Italian, Italian-Carni	12	6
Untested	7	6

The illustrations show two views of Rottneist Apiary and Bee-house, and one of a movable house apiary of Mr. Hoehegger, of Styria, containing 40 to 50 colonies of Carniolans.

## OAT VARIETY TRIALS—SOUTH-WEST.

G. K. BARON-HAY, Superintendent of Dairying.

The value of cereal crops has been specially stressed during the last two years to dairy farmers, the hay obtained from these crops being reserved and fed to dairy cattle during the flush period of the year when the feed available as pasture is composed almost entirely of leguminous plants, principally Subterranean Clover.

JARDEE.—On the property of Mr. J. W. Pritchard. Conducted by Agricultural Adviser M. Cullity.

Rate of Seeding : 2 bushels per acre.

Fertiliser : Superphosphate 2 cwt. per acre.

Land composed of friable loam having been under Clover for five years.

Yields are shown in the following table :—

Variety.	Planted.	Yield (average of 3 plots.)				Percentage Yield.
		tons.	cwts.	qrs.	lbs.	
Guyra ... ..	May 9th	2	2	3	6	129
Lachlan ... ..	do.	1	17	3	17	114
Burt's Early ... ..	do.	1	14	1	6	103
Algerian ... ..	do.	1	13	0	22	100
Mulga ... ..	do.	1	11	0	0	93

"Burt's Early" and "Mulga" were noted to grow rapidly in the early stages and were valuable as a source of early green feed.

DENMARK.—On the property of Mr. E. Russell, Group 42. Conducted by Agricultural Adviser G. Gauntlett.

Owing to heavy rains soon after these plots were sown, a considerable amount of "washing" was experienced, germination being poor.

Yields are as follow :

Variety.	Yield (Green) (average of 3 plots).				Percentage Yield.
	tons.	cwts.	qrs.	lbs.	
Algerian ... ..	2	14	2	27	100
Guyra ... ..	2	11	3	12	95
Lachlan ... ..	2	7	2	4	87
Mulga ... ..	2	7	2	4	87
Burt's Early ... ..	2	6	0	11	84

MARRADONG.—On the property of Mrs. L. Pollard. Conducted by Dairy Adviser C. Giles.

Land composed of good friable loam.

Seed sown at the rate of 60 lbs. per acre.

Superphosphate 1 cwt. per acre.

"Burt's Early" gave growth most suitable for early feed.

Yields are as follow :—

Variety.	Yield (Green) (average of 3 plots).				Percentage Yield.
	tons.	cwts.	qts.	lbs.	
Algerian ... ..	2	4	0	23	100
Lachlan ... ..	2	0	2	12	92
Burt's Early ... ..	1	18	0	0	86
Mulga ... ..	1	17	3	13	86
Guyra ... ..	2	1	0	22	93

The average percentage yields of the varieties of Oats used at the three centres named above indicate that for general planting a good strain of — " Algerian " compares favourably with other known varieties for hay purposes, " Burt's Early " or " Mulga " being specially valuable for the production of early feed.

The percentage yields are as follow :—

Algerian ... ..	100
Burt's Early ... ..	88
Lachlan ... ..	95
Guyra ... ..	98½
Mulga ... ..	99

## PEDIGREE SEED.

G. L. THROSSELL, Dipl. Agric., Agricultural Adviser.

The tremendous strides which have taken place in the development in wheat farming in Australia during this century are due to the improvement in cultural methods, which include the use of superphosphate, together with the breeding of cereals suited to the conditions under which they are grown. In the main the farming community has been quick in availing itself of anything new in regard to farming methods, but a factor which they do not seem to appreciate as much as they should, is the value of good quality seed. Stock breeders have long realised the importance of using pure bred sires and dams of high productivity and quality, combined with vigorous culling and selection for the improvement and maintenance of their flocks and herds. In this way the average production of milk and butter of dairy herds and of wool from the sheep flocks have been increased enormously.

In crop production systematic plant breeding and selection has raised the sugar content of the sugar beet from 6 to 7 per cent. of sugar to 20-25 per cent.

Similarly in wheat production the cereal breeders have evolved wheats of high yielding capacity, combined with drought and disease resistance, with grain of high flour strength. Whereas in the last century it was necessary to import wheats from Canada in order to blend the local wheats to produce a flour suitable for making bread, to-day the quality of Australain flour is unexcelled. The diseases which attack the growing wheat crop are gradually being overcome by the breeding of resistant varieties combined with the use of chemical fungicides. In this way the ravages of rust and smuts are being minimised.

The wheat farmer has an advantage over the stock breeder inasmuch that the successful stockbreeder must be a specialist in the art of culling and selecting in

order to maintain and improve his flock. The wheat farmer, on the other hand, does not require this specialised training. What he does require is a true appreciation of the value of seed of the best quality.

The requirements of a variety of wheat are that it—

- (1) is prolific, *i.e.*, of high yielding capacity;
- (2) is true to name and type, *i.e.*, free from admixture and foreign grains;
- (3) is suitable for the purpose for which it is grown;
- (4) will resist diseases;
- (5) will produce grain of good quality; and
- (6) that it does not have undesirable characteristics, such as weakness of straw, shedding, etc.

How can these qualities of excellence be maintained? If a farmer grades his wheat thoroughly he should eliminate all foreign matter, cracked, shrivelled and inferior grains, and obtain a plump uniform sample. This gives a uniform rate of seeding and produces a healthy vigorous wheat plant. An experiment conducted at the Wuyna Experiment Farm in Victoria in 1911 showed that the first quality graded wheat yielded 2 bus. 39 lbs. per acre more than the same wheat ungraded (harvester sample). Quite apart from the increased yield obtained, grading pays for itself on account of the screenings saved and available for stock feed, which otherwise would have been wasted.

However, grading alone cannot maintain the purity of the sample, nor evolve a better strain from the point of view of productivity, disease resistance, and other desirable characteristics. Modern farming machinery renders it almost impossible for even the most careful farmer to keep his varieties pure, with the result that in time the percentage of admixture increases and the value of that variety as a yielder and a disease resister is reduced.

Because of this the Department of Agriculture, in the interests of the farmer, carries out the intricate and specialised work of seed selection for the farmer. The work may be divided into three sections.

- (a) Selection to maintain the type and improve the varieties already in existence.
- (b) Cross breeding to produce better varieties; and
- (c) Disease resistance tests to improve the disease resistance of these varieties.

The varieties already in cultivation are submitted to tests for yielding qualities and disease resistance—and in this way prolific and disease resistant strains are evolved. The less prolific and resistant strains are rejected. Having evolved the best strains, sufficient seed is then raised for distribution to farmers. It must be remembered that this work is carried out each year, and the selection of improved strains is always going on.

These improved strains are made available to the farmer as pedigree graded seed, and as may be expected, cost a little more than ordinary seed wheat, but in proportion to its value to the wheat farmer the cost is indeed a small one. It is surprising to find farmers who do not mind paying large sums for stud rams, bulls, and other stud stock, and yet who will not pay a little extra for stud seed. Of course, to plant the whole area cropped with pedigree seed would certainly be an expensive proposition. The plan advocated is for a farmer to obtain each year a small lot, say, five to 10 bags of pedigree seed, depending on the total area cropped, of each of the varieties he grows. Then by planting this seed on carefully prepared clean fallow, free of self-sown wheat, and by keeping the seed drill and

harvesting machinery as clean as possible, he can raise his own seed with which to sow his bulk crop the following year.

Many farmers who realise the advantage of this practice follow this policy, and it pays them to do so. Good seed is a cog in the machinery of better crop production—if this cog is missing or broken the machinery cannot function properly.

## PEDIGREE SEED WHEAT AND OATS.

I. THOMAS,

Superintendent of Wheat Farms.

It has long been recognised amongst stock breeders how potent, for increasing the quality of their flocks and herds, is the use of stud animals selected specially for their productivity. Similarly, the value of the pedigree seeds of selected strains of plants chosen also for their high productivity and disease resistance, is now realised by up-to-date farmers.

One of the principal functions of the State Experiment Farms has been the production of selected pedigree seed of standard varieties of wheat and oats. In view of the special work and facilities required for the production and maintenance of the purity of this seed its cost is relatively high.

With a view to assisting the farmers in this present time of stress, and recognising that, owing to the abnormally low price of wheat ruling, some farmers may not be in a position to purchase selected pedigree seed, and will thus be prevented from taking advantage of the benefits to be derived from its use if the usual prices obtain, the Minister for Agriculture (Hon. P. D. Ferguson) has decided to make drastic reductions in them. This policy has been further influenced by an appreciation of the fact that the use of this seed is an important factor in promoting a greater yield per acre, and thereby reducing the costs of production.

With the exception of the new varieties "Beneubbin" and "Sutton," the prices are as under:—

*Wheat*—

For 10-bag lots and over—12s. per bag of 3 bushels.

Lots under 10 bags—14s. per bag of 3 bushels.

*Oats*—

For 10-bag lots and over—8s. per bag of 3 bushels.

Lots under 10 bags—10s. per bag of 3 bushels.

These will include rail freight to the siding nearest to the farmer's holding in the Wheat Belts.

The following varieties are at present available:—

*Wheat*.—Gluyas Early, Merredin, Nabawa, Noongaar, S.H.J., Yandilla King.

*Oats*.—Mulga.

In addition to the above varieties there is a small quantity of the new variety of wheat "Beneubbin" available. The price of this variety is £1 per bag, freight paid, as in the case of the other varieties. As the quantity of seed of "Beneubbin" is limited, and owing to the large number of applications already to hand, it has been found necessary to limit the amount to be supplied to any one applicant to one bag.

Any farmers desirous of obtaining pedigree seed wheat and oats of the above varieties should forward their application direct to the Department of Agriculture at an early date.

## DESCRIPTION OF STANDARD VARIETIES.

## WHEAT.

*Yandilla King*.—A late variety with stiff and upstanding straw; a profuse stooler and good yielder. It is the best variety of the late class, and because of its excellent record on varied conditions of soil and climate, it is considered the standard late variety. It is resistant to Flag Smut and Rust escaping, but susceptible to Bunt.

*Sutton*.—This is a new wheat produced by the Department of Agriculture, and is a cross between Nabawa and Carrabin. It is a late variety, maturing about the same time as Yandilla King, and is suitable both for hay and grain. It is fairly resistant to Bunt, resistant to Flag Smut, and no Summer Rust has been noticed on the straw.

*Nabawa*.—This variety has been produced by the Western Australian Department of Agriculture with the object of replacing "Federation" in those districts where the liability to Rust attacks renders the latter an undesirable variety. It has to its credit performances of great merit in both heavy and light land, and it has been found a prolific yielder in every district of the Wheat Belt; it is, therefore, the standard variety of the mid-season class. It is susceptible to Bunt, but resistant to Flag Smut.

*Bencubbin*.—A recent production of the Department of Agriculture is a cross between Nabawa and Gluyas Early, and promises to be an improvement on both parents for yield. It is of the same maturity as Nabawa, and is slightly taller in growth. It is equally resistant to Flag Smut, but is susceptible to Bunt.

*Gluyas Early*.—The standard variety of the "early" class. It has a great capacity for consistently yielding well under a low rainfall, but has a tendency to lodge, especially in heavy weather. It is very susceptible to Bunt and Flag Smut, but is resistant to Rust.

*Noongaar*.—This is also a recent production of the Department of Agriculture, and is probably the earliest variety in general cultivation in this State. In the trials at Kalgoorlie it has proved extremely drought resistant, and is now under trial in the extreme Eastern Belt, for which it is considered to be suitable for planting in the latter part of May. It is susceptible to Bunt, but resistant to Flag Smut.

## OATS.

*Algerian*.—This standard late maturing variety is more suitable for grain than hay, producing an excellent quality grain. Though a slower grower in its early stages, it makes rapid growth with the approach of warmer weather. It is not suitable for districts with low rainfall.

*Guyra*.—This is the standard mid-season variety in this State. It is a general purpose variety, being suitable for grazing, hay, grain and silage. It is, however, mostly favoured for grain production.

*Mulga*.—This variety is suitable for hay, grain and silage, maturing about the same time as Burt's Early, which variety it rivals in providing green feed for sheep. It yields well, produces grain of good quality, and is particularly suited for districts of low rainfall.

*Burt's Early*.—An early variety of oats, a quick and tall grower, which provides palatable and succulent green feed, as well as an excellent and heavy cut of hay. It is principally a hay variety, much valued by those who combine much stock carrying with their wheat growing.



## FIELD EXPERIMENTS WITH WHEAT, 1930.

### MERREDIN EXPERIMENT FARM

I THOMAS, Superintendent of Wheat Farms,  
and  
J H LANCEFIELD, Farm Manager

In addition to the experiments published in the March issue of the *Journal*, the following experiments were conducted at the Merredin Experiment Farm during 1930 —

Fallow and Non Fallow  
Time of Ploughing  
Mulching  
Nitrogen

The total rainfall for the year ending 31/12/30 was 13.33 inches, and during the growing period 8.23 inches. The following table shows the monthly rainfall together with the average over a period of 19 years —

Year	Jan	Feb	Mar	Apr	Growing Period							Nov	Dec	Total for year
					May	June	July	Aug	Sept	Oct	Total			
1930														
Average 19 years	5.3	1.56	28.12	18.79	4.130	3.3195	13.7188	18.4140	6.593	3.475	8.23821	1.44	4.154	133.33

The season opened with splendid rains during March and April, 4.67 inches being recorded, this was responsible for giving the weeds a good start before seeding commenced. May was a dry month, and lent itself admirably for killing the weeds, it was also responsible for allowing the seeding to proceed uninterrupted. Owing to the growth of weeds on the fallow it was necessary to cultivate several times in order to kill them. This was responsible for the loss of moisture in the surface soil, and delayed the germination of the May plantings until after rain, which fell on June 1st.

The season progressed very satisfactorily until September, when the rainfall was again very light, only 6.5 points being registered in that month in eight falls, the heaviest of which was 1.6 points. October was also dry (3.4 points only being recorded).

The land on which the experiments were planted originally carried a forest of salmon gum and gumlet, and the soil is typical of that class of country. The farm is worked on a three year rotation, namely fallow, crops (mainly wheat and oats) and pasture.

The experimental block received uniform treatment, being ploughed with a springtyne cultivated in March, after rain. Excepting where otherwise stated, or heavy disc plough to a depth of 4 in. in June, 1929, reploughed in August and where the requirements of an experiment necessitated a modification of the treatment, the fallow was given a further cultivation with a springtyne cultivator prior to seeding.

*Fallow v. Non-Fallow Experiment, 1930.*

The object of this experiment, which has been conducted since 1925, is to demonstrate the advantages of fallowing for the wheat crop.

Two plots, each one quarter of an acre in area, were set apart for the experiment, one of which was left unfallowed, and the other was ploughed 4 inches deep in July, 1929, with a disc plough, and springtyne cultivated in spring. The unfallowed plot was ploughed after rain on 11th March, 1930, the condition of the land being such that excellent work was done.

Both plots were springtyne cultivated in April and disc cultivated before seeding when they were in splendid condition. They were harrowed after being planted on May 23rd.

The results obtained are as follows:—

## FALLOW AND NON-FALLOW EXPERIMENT, 1930.

Variety -Glayas Early.

Planted on 23rd May, 1930.

Superphosphate -150lbs. per acre.

Seed - 45lbs. per acre.

Treatment.				Computed Yields per acre, 1930.		Percentage Yields, 1930.		Average Yields per acre, 1925-30.		Percentage Yields, 1925-30.	
				bush.	lbs.	%		bush.	lbs.	%	
Fallow	...	...	...	27	40	100		21	5	100	
Non-Fallow	...	...	...	28	44	104		15	14	72	

This is the first occasion since the inception of the experiment that the yields obtained from the unfallowed plots have been higher than those from the fallowed plots. From the average results for the past six years it will be seen that the fallowed plots have exceeded the unfallowed plots by nearly six bushels. It must also be remembered that the advantage of fallowing is most evident when the season is least favourable. The past season was a most favourable one, and the early March rains were particularly helpful in assisting in the preparation of a good seed-bed on the unfallowed plot. In addition, the heavy winter rains furnished an adequate moisture supply. The percentage results since 1925 illustrate the advantage of fallow in adverse years:—

Year.				Fallowed.		Unfallowed.	
				%		%	
1925	..	..	..	100	..	38	
1926	..	..	..	100	..	58	
1927	..	..	..	100	..	87	
1928	..	..	..	100	..	44	
1929	..	..	..	100	..	72	
1930	..	..	..	100	..	104	
Average				100	..	72	

*Time of Ploughing Experiment, 1930.*

A Time of Ploughing Experiment has been conducted at this farm for the past seven years, with the object of determining the effect of early and late winter fallowing on the resultant crops grown on heavy land. In the previous six years (1924-29) the experiment consisted of two plots, each half an acre in area, one representing early winter fallow, being ploughed during the first week in June, and the other, late winter fallow, ploughed the last week in August. The average results over this period are distinctly in favour of the early winter fallow.

## TIME OF PLOUGHING EXPERIMENT.

AVERAGE RESULTS, 1924-1929—(6 YEARS).

Time of Ploughing.	Average Yield per acre, 1924-29.		Average Percentage Yield per acre, 1924-29.
	bus.	lbs.	%
First week in June ... ..	18	46	100
Last week in August ... ..	14	55	80

This year the experiment was slightly modified, a third plot being included, the times of ploughing being respectively mid-June, mid-July and mid-August, and the area of the plots each one quarter of an acre. All plots were ploughed to a uniform depth of 4 inches with a disc plough, the land being in good order when the June and July plots were ploughed, but was becoming hard when the August plots were ploughed, and hence turned up cloddy.

All the plots received the same subsequent treatment, being springtyne cultivated in spring, March and April, and were disc cultivated in May prior to seeding on 23rd May and harrowed after.

During the growing period it was noticed that the June ploughed plot was practically free from Takeall, whilst there was a little of this disease showing in the July plot and several patches in the August plot. This fact has been observed in previous years.

The results obtained are as follow:—

## TIME OF PLOUGHING EXPERIMENT.

Variety—Gluyas Early.

Seed—45lbs. per acre.

Planted—23rd May, 1930.

Superphosphate—150lbs. per acre.

Time of Ploughing.	Computed Yield per acre, 1930.		Percentage Yield per acre, 1930.
	bus.	lbs.	%
Mid July ... ..	22	48	81
Mid June ... ..	28	0	100
Mid August ... ..	20	14	72

The results are in conformity with the average results from the previous six years and emphasise the advantage of early ploughing.

*Mulching Experiment, 1930.*

The object of this experiment, which has been conducted for the past 15 years, is to determine the extent and under what conditions the cultivation of winter fallowed land is profitable during the spring and summer.

Three plots were necessary, and to meet the requirements of the experiment they were treated as follows:—

Plot 1.—Cultivated during spring, again when required during summer after 25 points of rain or over, and again prior to seeding, the object being to maintain a mulch throughout the fallowed period and to destroy weed growth.

Plot 2.—Cultivated during spring and prior to seeding only (ordinary fallow).

Plot 3.—Cultivated prior to seeding only (neglected fallow).

The land upon which the experiment was conducted was typical salmon gum and gimlet timber country and was ploughed with a disc plough to a depth of 4 inches in June, 1929. Plots 1 and 2 were reploughed in August and Plot 1 received further cultivations after summer rains; all plots were springtyne cultivated in March and prior to seeding on 26th April.

A good germination was obtained, but owing to the dry conditions prevailing during May the plots made very slow growth during the early stages.

The results are shown in the following table:—

## MULCHING EXPERIMENT.

Planted on 26th April.

Variety—Nabawa.

Superphosphate—150lbs. per acre.

Seed—45lbs. per acre.

Cultivations.	Computed Yield per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1915-30.	Percentage Yields, 1915-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Mulched in spring, after rain during summer and before planting	35 20	34 8	34 16	33 44	34 48	34 27	100	21 42	102
Mulched in spring and before planting only	33 36	34 56	35 4	34 16	34 32	34 29	100	21 19	100
Mulched before planting only	33 52	34 24	34 48	33 36	33 28	34 2	99	20 14	95

There was very little difference in the yields of the plots this year. The average results for the whole period during which the experiment has been conducted, however, indicate that the general practice should be to cultivate the fallow during spring and again prior to seeding, and where the ground is weedy this cultivation should be supplemented by additional cultivations after rain during the summer months.

*Nitrogen Experiment, 1930.*

The objects of this experiment are:—

1. To determine whether increased yields are obtained when heavy dressings of sulphate of ammonia are applied to the wheat crop in addition to an application of superphosphate.
2. To ascertain whether it is advantageous to apply only part of this nitrogenous fertiliser at seeding time and part during the month of August.

For the purposes of the experiment two rates of sulphate of ammonia were applied, viz, 1 cwt and 2 cwt. respectively.

Superphosphate was applied to all plots at the rate of 150 lbs per acre, and those plots to which superphosphate only was applied were treated as controls. Comparisons were made between these control plots and those plots receiving 1 cwt. and 2 cwt. of sulphate of ammonia respectively. With each of these dressings the whole of the fertiliser was applied at the one time, viz, at seeding, in the one instance, and also, in separate plots, the application of half of the sulphate was delayed until the month of August.

All the plots, which were each one eighth of an acre in area, were repeated five times.

This experiment was conducted on fallowed and unfallowed land. The fallowed plots were ploughed in July, 1929, to a depth of 4 inches with a disc plough, and reploughed in August and springtine cultivated after rain in March. The unfallowed plots were ploughed after early rains in March. Both the fallowed and unfallowed land were then springtine cultivated in April and tandem disc cultivated prior to planting on 23rd May.

A good even germination was obtained.

The results were as follows.

#### NITROGEN EXPERIMENT

##### Fallow Section

Planted on 23rd May 1930

Variety: Gladys Early

Superphosphate 150lbs per acre

Seed 4 lbs per acre

Rate of Application of Sulphate of Ammonia per acre	Computed Yields per acre										Average Yields per acre 1930	Percentage Yield 1930	Percentage Yields 1929-30	
	Sec. 1		Sec. 2		Sec. 3		Sec. 4		Sec. 5					
1 cwt. at Seeding	1us 27	1bs 36	1us 28	1bs 16	1us 30	1bs 24	1us 27	1bs 12	1us 30	1bs 32	1us 28	1bs 40	102	101
Nil	26	36	28	40	28	36	26	32	29	36	28	38	100	100
2 cwt. at Seeding	29	44	29	36	29	44	28	36	29	20	29	12	104	104

##### Fallow Section

Planted on 23rd May 1930

Variety: Gladys Early

Superphosphate 150lbs per acre

Seed 4 lbs per acre

Rate of Application of Sulphate of Ammonia per acre	Computed Yields per acre										Average Yields per acre 1930	Percentage Yield 1930	Percentage Yields 1929-30	
	Sec. 1		Sec. 2		Sec. 3		Sec. 4		Sec. 5					
1 cwt. at Seeding in August	1 us 27	1 lb 34	1 us 29	1 lb 44	1 us 28	1 lb 36	1 us 30	1 lb 40	1 us 29	1 lb 20	1 us 29	1 lb 1	101	100
Nil	26	36	29	28	28	36	29	44	28	40	28	37	100	100
1 cwt. at Seeding in August	28	48	29	12	30	32	29	36	29	44	29	34	100	103

*Non-Fallow Section.*

Planted on 23rd May, 1930.

Variety -Gluyas Early.

Superphosphate—150lbs. per acre.

Seed—45lbs. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre.					Average Yields per acre, 1930	Percentage Yields, 1930.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
1 cwt. at Seeding ...	bus. lbs. 32 8	bus. lbs. 31 28	bus. lbs. 28 56	bus. lbs. 26 24	bus. lbs. 30 48	bus. lbs. 29 57	% 106	% 97
Nil ... ..	29 44	30 8	28 16	28 24	25 4	28 19	100	100
2 cwt. at Seeding ...	29 44	28 8	30 8	31 28	28 56	29 41	105	102

*Non-Fallow Section.*

Planted on 23rd May, 1930.

Variety -Gluyas Early.

Superphosphate—150lbs. per acre.

Seed—45lbs. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre.					Average Yields per acre, 1930	Percentage Yields, 1930.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
½ cwt. at Seeding; ½ cwt. in August	bus. lbs. 29 36	bus. lbs. 30 48	bus. lbs. 26 56	bus. lbs. 28 56	bus. lbs. 29 20	bus. lbs. 29 7	% 100	% 101
Nil ... ..	29 36	31 4	27 56	28 32	29 4	29 10	100	100
1 cwt. at Seeding; 1 cwt. in August	30 24	28 32	29 12	29 12	31 20	29 41	102	103

The results obtained over the two years that the experiment has been conducted indicate that the applications of heavy dressings of ammonium sulphate do not give any significant increase in the yields either from fallowed or unfallowed land.

## FIELD EXPERIMENTS WITH WHEAT, 1930.

## CHAPMAN EXPERIMENT FARM.

L. THOMAS, Superintendent of Wheat Farms.  
and

F. L. SMER, B.Sc. (Agric.), Farm Manager.

The following experiments, in addition to those published in the March issue of the *Journal*, were conducted at the Chapman Experiment Farm last year:—

Time of Ploughing.  
Depth of Ploughing.  
Mulching.  
Nitrogen.

The land in which the experiments were conducted varied from typical jam (*Acacia acuminata*) country to that of lighter timber country and had been cleared some years previously.

The past season was a rather adverse one for wheat-growing at this farm. The total rainfall for the year was 1,965 points, of which 1,856 points fell during the growing period. Such a heavy rainfall during these months has only been exceeded previously four times in twenty-five years.

The following is the rainfall for 1930, together with the 25 years' average:—

Year.	Jan.	Feb.	Mar.	Apr.	Growing Periods.						Nov.	Dec.	Total for year.	
					May.	June.	July.	Aug.	Sept.	Oct.				Total.
1930	...	...	34	57	117	915	400	159	121	84	1,856	14	4	1,065
Average, 25 years	26	48	65	44	234	438	399	263	162	96	1,592	29	22	1,826

No rain of any consequence fell until 9th May, and in view of past experience it was necessary to delay seeding until the rains had germinated the weed seeds. As an indication of the lateness of the season less than half the average rainfall for the period January-May had been recorded by the end of May. No less than 915 points fell during June, resulting in boggy and water-logged soil conditions which further delayed seeding operations and retarded the growth of crops already planted, particularly those in the low-lying portions of the paddocks. July was also a very wet month, but with the advent of warmer and drier conditions in August the growing conditions improved.

#### *Time of Ploughing Experiment, 1930.*

The object of this experiment, which has been conducted for the past two years, is to ascertain whether the time of carrying out the initial operation of fallowing, i.e., ploughing, has any effect upon the yields of the resultant crop.

For the purpose of the experiment, three sets of plots were required—

Plot 1—Ploughed in March (long summer fallow).

Plot 2—Ploughed in June (early winter fallow).

Plot 3—Ploughed in August (late winter fallow.)

The plots, each one-eighth of an acre in area, were repeated five times.

All plots were ploughed to a depth of 4 inches at the respective times. The March plots were springtyne cultivated in June, on account of weed growth, and the whole experiment was cultivated in September, and again prior to seeding on 16th May.

The variety Nabawa was sown at the rate of 60 lbs. per acre, superphosphate being applied at the rate of 112 lbs. per acre.

The results obtained are as hereunder:—

#### TIME OF PLOUGHING EXPERIMENT.

Planted on 16th May, 1930.

Variety—Nabawa.

Superphosphate—112lbs. per acre.

Seed—60lbs. per acre.

Time of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1929-30.	Per-centage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
26th March, 1929	bus. lbs. 10 32	bus. lbs. 9 36	bus. lbs. 8 56	bus. lbs. 10 16	bus. lbs. 10 0	bus. lbs. 9 52	% 92	bus. lbs. 9 58	% 90
22nd June, 1929	...	9 52	10 0	9 20	11 28	13 12	100	11 6	100
12th August, 1929	...	9 52	10 0	11 28	12 16	12 48	105	10 6	91

The results are for two years only and hence cannot be taken as conclusive. The average results indicate that the best returns are obtained from early winter fallow.

*Depth of Ploughing Experiment.*

The object of this experiment, which has been conducted since 1915, is to determine the most economical depth of ploughing for wheat growing on fallowed land.

Three plots were required and were ploughed as follows:—

Plot 1—4 inches, representing shallow ploughing.

Plot 2—6 inches, representing medium ploughing.

Plot 3—8 inches, representing deep ploughing.

The plots, which were each one-eighth of an acre in area, were repeated five times.

The land on which the experiment was conducted originally carried jam and wattle. It was ploughed during June, 1929, with a mouldboard plough and spring-tyne cultivated in August and September, and again prior to seeding.

The variety Nabawa was planted on 16th May at the rate of 60 lbs. per acre, superphosphate being applied at the rate of 112 lbs. per acre.

The results obtained are as follows:—

## DEPTH OF PLOUGHING EXPERIMENT, 1930.

Variety : Nabawa.

Planted on 16th May, 1930.

Superphosphate—112lbs. per acre.

Seed—60lbs. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1915-30.	Per-centage Yields, 1915-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
4 inches ... ..	15 44	17 52	16 0	16 48	16 32	16 35	88	15 6	99
6 „ ... ..	15 44	19 28	20 32	20 0	18 24	18 50	100	15 14	100
8 „ ... ..	19 44	20 32	16 56	19 44	20 16	19 26	103	15 43	103

The results this year, as they have been for the past two years, are in favour of the deeper ploughing. However, the average results since the inception of the experiment in 1915, show that the most economical depth to plough this class of country is 4 inches. They also show that the yields are not decreased when the land is ploughed deeper.

*Mulching Experiment, 1930.*

The object of this experiment is to determine to what extent the cultivation of winter fallowed land is profitable during the spring and summer months.

The experiment has been conducted since 1914, and, as in previous years, the following system of cultivation was adopted.

Plot 1 (well worked fallow) : Cultivated during spring, when required during summer after 25 points of rain or over, and again prior to seeding, the object being to maintain a mulch throughout the fallowed period and to destroy weed growth.

Plot 2 (ordinary fallow—control) : Cultivated during spring and prior to seeding only.

Plot 3 (neglected fallow) : Cultivated prior to seeding only.



The land was ploughed in July, 1929, and the plots were cultivated as follows:—Plot 1 was cultivated in September, November, March, April and before seeding, i.e. five times. Plot 2 was cultivated in September and prior to seeding, and Plot 3 was cultivated before seeding only. All plots were repeated five times. The results for this year and the average results for 1930 are as follows:—

## MULCHING EXPERIMENT.

Planted on 21st May, 1930.

Variety—Nabawa.

Superphosphate—112lbs. per acre.

Seed—60lbs. per acre.

Cultivations.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1914-30.	Percentage Yields, 1914-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs. 10 0	bus. lbs. 9 52	bus. lbs. 9 52	bus. lbs. 10 0	bus. lbs. 10 32	bus. lbs. 10 3	% 100	bus. lbs. 14 47	% 108
Mulched in spring, after rains during summer, and before seeding	10 0	10 16	10 8	10 8	9 44	10 3	100	13 44	100
Mulched in spring, and before seeding (Control)									
Mulched before seeding only	12 32	9 36	9 36	10 0	9 44	10 18	102	12 39	92

The difference in yields in the plots this year is not significant. The average results for the sixteen years that the experiment has been conducted indicate, however, that the most economical working of the fallow is to cultivate in spring and prior to seeding. It is pointed out, however, that where weeds are bad, it is advisable to make use of summer rains to destroy weeds by cultivation.

*Nitrogen Experiment, 1930.*

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of a nitrogenous fertiliser are applied to the wheat crop in addition to an application of superphosphate.

For the purposes of the experiment two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwt. respectively.

Superphosphate was applied to all plots at the rate of 112 lbs. per acre, and those plots to which superphosphate only was applied were treated as controls. Comparisons were made between these control plots and those plots receiving 1 cwt. and 2 cwt. of sulphate of ammonia respectively. With each of these dressings the whole of the fertiliser was applied at the one time, viz., at seeding.

The experiment was conducted on both fallowed and unfallowed land, all plots being repeated five times. The fallowed land was ploughed in August, 1929, with a mouldboard plough and springtyne cultivated during September and again prior to seeding. The unfallowed land was mouldboard ploughed on June 2nd, 1930, and then harrowed, and all plots were seeded on 6th June, the variety Nabawa being sown at the rate of 60 lbs. of seed and superphosphate applied at 112 lbs. per acre.

The results obtained are shown hereunder:—

### NITROGEN EXPERIMENT.

#### FALLOW.

Variety—Nabawa.

Planted on 6th June, 1930.

Superphosphate—112lbs. per acre.

Seed—60lbs. per acre.

Rate of Application of Ammonium Sulphate per acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
1 cwt. ... ..	bus. lbs. 6 16	bus. lbs. 6 32	bus. lbs. 7 28	bus. lbs. 7 52	bus. lbs. 8 40	bus. lbs. 7 22	% 100	% 109
Nil ... ..	6 48	7 28	6 56	7 44	7 44	7 20	100	100
2 cwt. ... ..	7 12	6 24	7 12	7 28	7 12	7 6	96	105

#### NON-FALLOW.

Variety—Nabawa.

Planted on 6th June, 1930.

Superphosphate—112lbs. per acre.

Seed—60lbs. per acre.

Rate of Application of Ammonium Sulphate per acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
1 cwt. ... ..	bus. lbs. 10 40	bus. lbs. 11 44	bus. lbs. 8 56	bus. lbs. 9 4	bus. lbs. 10 0	bus. lbs. 10 5	% 133	% 117
Nil ... ..	8 56	8 24	6 56	6 24	7 12	7 34	100	100
2 cwt. ... ..	10 8	9 36	8 24	8 40	8 16	9 1	119	133

As this experiment has been conducted for two years only, no definite conclusions can be arrived at. The average results indicate that on this class of soil the nitrogenous fertiliser produces greater increased yields on the unfallowed than on the fallowed land. On both sections this year, plots receiving at the rate of 2 cwt. of nitrogenous fertiliser did not yield as well as those plots receiving a dressing of 1 cwt.

## FIELD EXPERIMENTS WITH WHEAT, 1930.

### WONGAN HILLS LIGHT LANDS FARM.

I. THOMAS, Superintendent of Wheat Farms, and

A. R. VENTON, Farm Manager.

The following experiments with potash and nitrogenous fertilisers were conducted at the Wongan Hills Light Lands Farm during 1930, in addition to those published in the March issue of the Journal.

The past season was more favourable for the growth of the crop than that of the previous year; although the rainfall was again below the average, it was more evenly distributed.

The following table shows the monthly rainfall for 1929 and 1930 as recorded at the farm, together with the averages for the past 17 years as officially recorded at the Wongan Hills township, four miles distant.

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period.						Nov.	Dec.	Total for Year.	
					May.	June.	July.	Aug.	Sept.	Oct.				Total.
1930 ... ..	7	...	53	92	66	367	321	149	90	55	1,048	1	98	1,299
1929 ... ..	22	217	85	...	261	426	172	140	35	141	1,175	38	4	1,541
17 years' average ...	44	55	97	62	196	306	273	195	126	94	1,191	41	49	1,538

Useful rains fell in April, and those varieties planted during that month obtained a good start. The latter part of May was warm and dry, and as a result a little malting occurred in those portions of the crop planted after the first week in May.

The land on which the experiments were conducted was virgin country prior to being fallowed in 1929, consisted mainly of the smokebush and tussocky types of sand plain. It was ploughed from June to early August, 1929, with a disc implement (Sundercut), cross cultivated with the same implement during August and September, and again cultivated with the same implement in March and early April. Prior to seeding it was tandem disc cultivated. Excepting where the requirements of an experiment necessitated otherwise, the cultural details for all the experiments were as outlined.

#### *Potash Experiment, 1930.*

The object of this experiment is to determine whether any advantage is derived by supplementing the dressing of superphosphate with a potassic manure for growing a wheat crop on light land.

Three fertilisers were used and were applied as follows:—

Plot 1—150 lbs. superphosphate + 56 lbs. muriate of potash per acre.

Plot 2—150 lbs. superphosphate per acre (control).

Plot 3—150 lbs. superphosphate + 140 lbs. kainit per acre.

This section of plots, each one-eighth of an acre, was repeated five times. The quantity of potash stated as  $K_2O$  is the same in 56 lbs. of the muriate as in 140 lbs. of the kainit.

The potassic fertilisers were applied to the respective plots about four weeks before seeding. This course is considered advisable owing to the risk of injuring the young plants incurred by applying a fertiliser of this type at seeding time.

Germination was fairly even, growth throughout the season was healthy, and at no time during the season could any difference be discerned between the plots.

Unfortunately harvesting operations on this experiment were interrupted by heavy rain and strong wind. The five plots which were harvested after the storm had lodged somewhat and only the results of three sections harvested prior to the storm were used for comparison.

## MIXED FERTILISER EXPERIMENT.

Planted on 29th April, 1930.

Variety—Nabawa.

Superphosphate—150lbs. per acre.

Seed—45lbs. per acre.

Potash applied per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per- centage Yields, 1930.	Average Yields per acre, 1927-30.	Per- centage Yields, 1927-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
Muriate of Potash, 56lb.	bus. lbs. †	bus. lbs. †	bus. lbs. 16 24	bus. lbs. 15 44	bus. lbs. 16 40	bus. lbs. 16 16	% 98	bus. lbs. 15 18	% 99
No Potash ...	†	†	16 40	16 8	16 56	16 35	100	15 26	100
Kainit, 140lb. ...	†	15 20	16 8	16 24	16 24	16 19	98	15 26	100

† Plots damaged by heavy weather. Only Sections 3, 4, and 5 used in calculations.

The results of this year and also the average results for the four years during which the experiment has been conducted, show that the yields are not increased by applying a potassic fertiliser to this class of soil.

*Nitrogen Experiment, 1930.*

The objects of this experiment which was carried out on fallowed and unfallowed land are:—

- (a) To determine whether increased yields are obtained when heavy dressings of sulphate of ammonia are applied to the wheat crop in addition to an application of superphosphate, and
- (b) To ascertain whether it is advantageous to apply only part of this nitrogenous fertiliser at seeding time and part during the month of August (spring).

For the purposes of the experiment, two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwt. respectively.

Superphosphate was applied to all plots at the rate of 150 lbs. per acre, and those plots to which superphosphate only was applied were treated as controls. Comparisons were made between these control plots and those plots receiving 1 cwt. and 2 cwt. of sulphate of ammonia per acre respectively. With each of these dressings the whole of the fertiliser was applied at the one time, viz., at seeding, in the one instance, and also, in separate plots, the application of half of the sulphate was delayed until the month of August.

The fallowed land was of the smokebush type of country and was ploughed in June-July, 1929, with a disc cultivating plough and cross cultivated in October with the same implement. In January it was scrub-raked and in March disc cultivated and tandem disced prior to seeding on 24th April, 1930.

The non-fallowed land was ploughed a few days prior to seeding on 7th May.

Germination was good on both the fallow and non-fallow sections. From the end of May onwards the plots treated with the sulphate of ammonia appeared more robust. A very marked difference was also apparent between the effects of the various dressings of the nitrogenous fertiliser. As the season advanced this difference became more apparent, the plots being denser and taller according to the quantity of sulphate of ammonia used. The additional dressings, however, at the end of August made no visible difference. In the fallowed section, the control plots matured seven to eight days later than the remainder and on the non-fallow six to seven days later.

It was noticed on both sections that those dressed with nitrogenous fertilisers lodged at maturity, this being more pronounced on the fallow section where the growth was more rank.

No difference could be observed in the growth of the plots which were top-dressed in August.

The results obtained are as follows:—

#### NITROGEN EXPERIMENT.

##### NON-FALLOW SECTION.

Planted on 7th May, 1930.

Variety—Nabawa.

Superphosphate—150lbs. per acre.

Seed—45lbs. per acre.

Rate of application of Sulphate of Ammonia per acre.	Computed Yields per acre.					Average Yields per acre, 1930.	Percent-age Yields, 1930.	Percent-age Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
56lbs. at seeding; 56lbs. in August	bus. lbs. 18 48	bus. lbs. 17 4	bus. lbs. 17 44	bus. lbs. 18 0	bus. lbs. 18 56	bus. lbs. 17 42	% 106	% 116
Nit ... ..	16 0	15 36	17 12	17 52	16 56	16 43	100	100
112lbs. at seeding; 112lbs. in August	17 12	17 36	17 28	16 32	16 32	17 4	102	112

##### NON-FALLOW SECTION.

Planted on 7th May, 1930.

Variety—Nabawa.

Superphosphate—150lbs. per acre.

Seed—45lbs. per acre.

Rate of application of Sulphate of Ammonia per acre.	Computed yields per acre.					Average Yields per acre, 1930.	Percent-age Yields, 1930.	Percent-age Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
112lb. at Seeding ...	bus. lbs. 17 36	bus. lbs. 18 8	bus. lbs. 17 44	bus. lbs. 17 28	bus. lbs. 16 56	bus. lbs. 17 34	% 100	% 111
Nit ... ..	16 8	18 8	18 48	17 44	17 20	17 38	100	100
224lb. at Seeding ...	15 12	16 56	15 44	16 8	17 20	16 16	92	108

##### FALLOW SECTION.

Planted on 24th April, 1930.

Variety—Nabawa.

Superphosphate—150lbs. per acre.

Seed—45lbs. per acre.

Rate of application of Sulphate of Ammonia per acre.	Computed Yields per acre.					Average Yields per acre, 1930.	Percent-age Yields, 1930.	Percent-age Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
112lbs. at Seeding ...	bus. lbs. 22 0	bus. lbs. 21 52	bus. lbs. 19 44	bus. lbs. 20 24	bus. lbs. 21 28	bus. lbs. 21 6	% 132	% 146
Nit ... ..	16 56	16 0	14 32	16 16	15 52	15 55	100	100
224lbs. at Seeding ...	21 52	22 8	21 12	21 36	24 8	22 11	139	146

## FALLOW SECTION.

Planted on 24th April, 1930.

Variety--Nabawa.

Superphosphate--150lbs. per acre.

Seed--45lbs. per acre

Rate of application of Sulphate of Ammonia per acre.	Computed Yields per acre.					Average Yields per acre 1930.	Percentage Yields, 1930.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
56lbs. at Seeding; 56lbs. in August	bus. lbs. 18 56	bus. lbs. 19 20	bus. lbs. 22 0	bus. lbs. 21 4	bus. lbs. 20 48	bus. lbs. 20 26	% 124	% 131
Nil ... ..	15 28	16 8	16 48	17 12	16 32	16 26	100	100
112lbs. at Seeding; 112lbs in August	20 32	20 40	22 0	22 0	22 24	21 31	131	142

The results on the fallowed plots show that a dressing of nitrogenous manure when applied at seeding time gives greater yields than when portion is applied at seeding and the balance during spring, and there is, apparently, no benefit to be obtained by increasing these dressings above 1 cwt. per acre. This experiment has been carried out for two years only, and these conclusions need further confirmation before they can be accepted.

The results do, however, demonstrate that this class of soil is very deficient in nitrogen.

## FIELD EXPERIMENTS WITH WHEAT, 1930.

## SALMON GUMS EXPERIMENT FARM.

I. THOMAS, Superintendent of Wheat Farms,  
and

L. G. SEINOR, Farm Manager.

The following experiments were conducted at the Salmon Gums Experiment Farm during 1930 in addition to those published in the March issue of the *Journal*:—

Time of ploughing.

Depth of ploughing.

Mulching.

Nitrogen.

The rainfall for the greater part of the past season was favourable for the growth of the wheat crops. The heavy rains which fell in March facilitated the preparation of a good seed bed in addition to assuring reserves of moisture in the subsoil. Seeding operations were carried out under ideal conditions, and the germination of the seed was excellent. Favourable growing conditions continued until the end of August. Light falls were recorded during September, but the crops did not derive full advantage from these because of the drying winds which were later experienced.

The monthly rainfall, as recorded at the farm for both years 1930 and 1929, together with the average for the past 12 years as recorded at Salmon Gums, one mile distant, is as follows:—

—	Jan.	Feb.	Mar.	Apr.	Growing Periods.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
At Farm, 1930 ...	...	...	312	102	269	156	92	230	73	17	837	14	208	1,623
At Farm, 1929 ...	106	65	73	26	125	207	159	163	21	35	710	150	43	1,173
Average, 1926-30 ...	33	35	203	99	133	113	139	167	80	88	720	40	74	1,204
Salmon Gums Town, 1919-30 ...	29	46	128	113	165	151	132	141	110	118	812	75	98	1,301

The area on which the experiments were planted, originally carried silver mallee, silver bark, tea tree and other light mallee, and was cleared in 1926, fallowed 1927, and cropped in 1928. In preparation for the planting this year it was ploughed to a depth of 4in. with a disc-cultivating plough in June-July, 1929, cross ploughed in November, springtyne cultivated in January, and prior to seed-ing.

#### *Time of Ploughing Experiment, 1930.*

The object of this experiment is to ascertain whether the time of carrying out the initial operation of fallowing, *i.e.*, ploughing, has any effect upon the yields of the resultant wheat crop.

Three plots, treated in the following manner, were required:—

Plot 1.—Ploughed in March, 1929. (Long summer fallow.)

Plot 2.—Ploughed in June, 1929. (Early winter fallow.)

Plot 3.—Ploughed in September, 1929. (Late winter fallow.)

Each plot was repeated five times.

The land on which the experiment was conducted was cleared in 1927 of its original vegetation of gimlet-mallee, silver bark and tea tree scrub. It was fallowed in 1927, cropped in 1928 and then ploughed according to the requirements of the experiment in 1929.

All plots were cultivated in November and again prior to seeding.

The results obtained are set out hereunder:—

#### TIME OF PLOUGHING EXPERIMENT, 1930.

Variety -Nabawa.	Planted on 6th May.					Superphosphate --112 lbs. per acre.			Seed --45 lbs. per acre.		
Time of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1928-30.	Per-centage Yields, 1928-30.		
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.						
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%		
March.											
Long summer fallow ...	13 4	11 52	12 0	12 8	11 36	12 8	92	12 30	96		
June.											
Early winter fallow ...	14 8	12 16	12 48	13 4	13 52	13 14	100	13 3	100		
September.											
Late winter fallow ...	12 56	11 52	12 0	12 0	12 0	12 10	92	12 6	93		

The results obtained this year and the average results for the past three years indicate that the early winter ploughing gives the best results. Thus ploughing should be commenced as soon as possible after seeding has been completed as the results indicate that the earlier the initial operation is completed during the winter months the better.

*Depth of Ploughing Experiment, 1930.*

The object of this experiment, which has been conducted for the past two years, is to determine the most economical depth to plough for the wheat crop.

Three plots, each repeated five times, were required, one ploughed to a depth of 2 inches, one to 4 inches and one to 5 inches. The type of implement available did not permit of the third plot being ploughed to a depth of 6 inches, as was originally intended.

The land on which the experiment was conducted originally carried gimlet mallee, silver bark and tea tree, and was cleared and fallowed in 1927, cropped 1928 and ploughed, according to the requirements of the experiments, in June, 1929. It was dise cultivated in November and springtyne cultivated in January and prior to seeding on May 7th.

Greater difficulty was experienced in obtaining a good seed-bed in the 2-inch ploughing than in the deeper ploughing. During the early stages of growth little difference in appearance could be detected in the various plots, but when the late spring rains were deficient the deeper ploughing showed to advantage.

The results obtained are set out below:—

## DEPTH OF PLOUGHING EXPERIMENT. 1930.

Variety—Nabawa. Planted on 7th May, 1930. Superphosphate—112lbs. per acre. Seed—45lbs. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929-30.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
2 inches	bus. lbs. 11 12	bus. lbs. 11 52	bus. lbs. 10 24	bus. lbs. 11 4	bus. lbs. 11 28	bus. lbs. 11 12	% 87	bus. lbs. 12 14	% 90
4 "	12 0	12 56	13 44	12 16	13 44	12 56	100	13 32	100
"	11 52	12 56	13 44	12 8	13 36	12 51	99	13 0	96

Although no definite conclusion can be arrived at from the result of two years' experiments, there is an indication in this and the previous year's results that 4 inches is sufficient depth to plough. In this district, where mallee stumps are abundant, it will be found that by ploughing to a depth of 4 inches a greater proportion of stumps can be removed than by shallow ploughing. With the shallow ploughing also, it is difficult to maintain a suitable mulch and prepare a good seed bed.

*Mulching Experiment, 1930.*

The object of this experiment is to determine how far and under what conditions the cultivation of winter fallowed land during the spring and summer months is profitable.

For this purpose three plots were required.

Plot 1.—Cultivated during spring, again during summer after 25 points of rain or over, and again before seeding, the object being to maintain a mulch during the fallowed period and to destroy weed growth.

Plot 2.—Cultivated during spring and prior to seeding only.

Plot 3.—Cultivated prior to seeding only.

Each plot was repeated five times, the experiment being conducted on land which was ploughed in June, 1929.



The variety Nabawa was planted on 3rd May, 1930, at the rate of 45 lbs. per acre. Superphosphate was applied at the rate of 112 lbs. per acre.

The results are tabulated below:—

#### MULCHING EXPERIMENT, 1930.

Variety—Nabawa. Planted on 3rd May, 1930. Superphosphate—112lbs. per acre. Seed—45lbs. per acre.

Treatment.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929-30.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Cultivated in spring, after summer rains and before seeding	13 30	12 16	12 8	12 24	*	12 36	105	13 21	104
Cultivated in spring, and before seeding	10 8	12 56	12 24	12 24	*	11 58	100	12 52	100
Cultivated before seeding only	12 0	11 52	12 48	13 20	*	12 30	104	13 15	103

\* Discarded owing to accident at seeding.

No definite conclusions can be arrived at, as this experiment has only been conducted for two years.

#### Nitrogen Experiment, 1930.

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of sulphate of ammonia are applied to the wheat crop in addition to an application of superphosphate.

For the purpose of the experiment, which was conducted on both fallowed and unfallowed land, two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwt. respectively. Superphosphate was applied to all plots at the rate of 1 cwt. per acre, and those plots to which superphosphate only was applied were treated as controls. The whole of the fertiliser was applied at seeding time, all plots being repeated five times.

The land for the fallowed section was ploughed in June, 1929, disc cultivated in October, springtyne cultivated in November and again prior to seeding.

The unfallowed land which had been cropped two years previously, was only springtyne cultivated prior to seeding.

All plots were planted on 9th May, 1930, the variety Nabawa being sown at the rate of 45 lbs. per acre.

The plots to which the nitrogenous fertiliser was applied showed to advantage during the winter, being easily distinguished by the density of growth and the dark green colour of the flag. They made better growth until the spring when, owing to the dry weather conditions, they suffered more than the control plots.

The results obtained are set out below:—

#### NITROGEN EXPERIMENT, 1930.

##### FALLOW SECTION.

Variety—Nabawa. Planted on 9th May, 1930. Superphosphate—112lbs. per acre. Seed—45lbs. per acre.

Rate of Application of Ammonium Sulphate per acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
1 cwt. ... ..	12 16	14 24	14 24	13 4	14 24	13 42	92	95
N ... ..	16 0	14 40	15 4	14 16	14 40	14 56	100	100
2 cwt. ... ..	13 28	14 8	12 48	13 44	12 48	13 23	90	90

## NON-FALLOW SECTION.

Variety—Nabawa. Planted on 9th May, 1930. Superphosphate—112lbs. per acre. Seed—45lbs. per acre.

Rate of Application of Ammonium Sulphate per acre.	Computed Yields per Acre.					Average Yields per Acre. 1930.	Percentage Yields 1930.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
1 cwt. ... ..	10 56	12 16	12 40	12 40	11 36	12 2	95
Nil ... ..	12 48	12 56	12 48	12 8	12 48	12 42	100
2 cwt. ... ..	12 56	12 0	12 48	12 16	11 36	12 19	97

Although these results are for two years only they indicate that there is no advantage in using heavy dressings of sulphate of ammonia either on fallowed or unfallowed land of this nature.

## FIELD EXPERIMENTS WITH WHEAT, 1930.

## YILGARN EXPERIMENT FARM.

## I. THOMAS, Superintendent of Wheat Farms.

In addition to the experiments published in the March issue of the *Journal*, the following experiments were conducted at the Yilgarn Experiment Farm during 1930:—

Time of Ploughing.

Depth of Ploughing.

Mulching.

Nitrogen.

Since cropping operations have been carried out at the farm (these commencing in 1929), the rainfall during the growing periods has been below that of the average for Southern Cross (a distance of 8 miles West) for the past 40 years.

The monthly registrations at the farm for 1930, together with the average for the past three years, and the average as recorded at Southern Cross for the past 40 years are set out hereunder:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1930 ... ..	...	167	62	209	87	229	88	110	45	9	568	10	173	1,189
Average 3 years ...	43	95	58	86	177	150	104	75	34	25	565	101	77	1,025
Southern Cross average, 40 years ...	49	61	107	79	138	141	145	110	80	61	675	43	46	1,060

Following good rains during the months of February and March, copious rains were experienced in April, resulting in the subsoil becoming well supplied with moisture. These April rains caused seeding operations to be delayed, but after the first week in May no further rain was recorded during that month, which enabled seeding to be proceeded with without interruption. Some anxiety, however,

was caused by this prolonged dry period, as it was feared that malting of the seed would occur in the crops sown after the middle of May. This anxiety was relieved, by rains early in June. During the remainder of that month further good rains were recorded and owing to the mild climatic conditions which prevailed during July and August, the crops made vigorous growth. Unfortunately these favourable growing conditions did not continue into September. During this month the rainfall was scanty and several severe frosts occurred, combined with hot drying conditions during the day, which affected the crops. Little or no rain was experienced in October, so that they matured under adverse conditions, when it became apparent that the yields of earlier expectations would not be realised.

The land on which the experiments were conducted was originally timbered with salmon gum and gimlet, and was cleared in 1928. During June and July, 1929, in preparation for planting, it was ploughed with a disc cultivating plough to a depth of 4 inches. In September it was cultivated with a springtyne implement and was again cultivated with the same implement in February, after rain and prior to seeding.

Unless otherwise stated, these cultural operations refer to the land on which the experiments set out below were planted.

#### *Time of Ploughing Experiment, 1930.*

The object of this experiment is to determine to what extent the time of ploughing affects the yields of the resulting crop.

For this experiment, three plots were required:—

Plot 1—Ploughed in March (long summer fallow).

Plot 2—Ploughed in June (early winter fallow).

Plot 3—Ploughed in August (late winter fallow).

Each plot was repeated five times. Subsequent to the initial operation of ploughing, the plots were springtyne cultivated in September and prior to seeding, which took place on May 6th. Portion of the seed germinated on May 14th, the balance not until after rain on June 7th.

The results are set out below:—

#### TIME OF PLOUGHING EXPERIMENT.

Planted on 6th May, 1930.

Variety—Gluyas Early.

Superphosphate—112lbs. per acre.

Seed—30lbs. per acre.

Time of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929-30.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
March, 1929 ...	10 8	15 44	9 4	13 52	14 8	12 35	83	10 85	86
June, 1929 ...	14 32	16 8	16 48	13 44	14 24	15 7	100	12 18	100
August, 1929 ...	16 16	15 36	10 40	9 52	14 32	13 23	89	10 19	84

The results are for two years only, so that no definite conclusions can be arrived at. However, they are in conformity with similar experiments conducted at the other experiment farms, and stress the value of early winter fallow.

*Depth of Ploughing Experiment, 1930.*

The object of this experiment is to ascertain the comparative effect upon the resultant wheat crop of ploughing the land to different depths.

For the purpose of the experiment three plots were required, and were ploughed as follows:—

Plot 1—2 inches, representing shallow ploughing.

Plot 2—4 inches, representing medium ploughing.

Plot 3—6 inches, representing deep ploughing.

The plots were each one-eighth of an acre in area and were repeated five times. They were ploughed to the respective depths with a disc implement in June, 1929, and all the plots were springtyne cultivated during September and prior to seeding, which took place on 6th May. The variety Gluyas Early was sown at the rate of 30 lb. per acre and superphosphate was applied at the rate of 112 lb. per acre.

The results are as hereunder:—

## DEPTH OF PLOUGHING EXPERIMENT.

Planted on 6th May, 1930.

Variety—Gluyas Early.  
Seed—30lbs. per acre.

Superphosphate—112lbs. per acre.

Depth of Ploughing.	Computed Yields per Acre					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929-30.	Percentage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
2in. deep ...	16 24	16 16	16 16	15 28	10 40	15 1	103	11 11	101
4in. deep ...	14 48	14 56	14 24	14 8	14 32	14 34	100	11 6	100
6in deep ...	15 20	12 32	13 4	11 44	11 4	12 45	88	10 34	95

As the experiment has been conducted for two years only, no definite conclusion can be arrived at. Although a slight increased yield was obtained from the shallow ploughing this season, it is considered advisable on account of the difficulty in maintaining the mulch during the summer on the 2-inch ploughing to plough to a greater depth.

*Mulching Experiment, 1930.*

The object of this experiment is to determine how far, and under what conditions, the working of winter fallowed land is profitable during the spring and summer months.

Three plots were necessary to meet the requirements of the experiment, and they were treated as follows:—

Plot No. 1 (Well worked fallow).—Cultivated during spring, again when required during summer, after 25 points of rain or over, and again prior to seeding, the object being to maintain a mulch throughout the fallowed period and to destroy weed growth.

Plot No. 2 (Ordinary fallow).—Cultivated during spring and prior to seeding only.

Plot No. 3 (Neglected fallow).—Cultivated prior to seeding only.

Plot 1 this year received cultivations with a springtyne cultivator in September, February, March, and prior to seeding. Plot 2 was cultivated in September and prior to seeding, while Plot 3 was cultivated prior to seeding only.

The variety Gluyas Early was planted on 7th May, 1930, at the rate of 30 lb. of seed per acre, superphosphate being applied at the rate of 112 lb. per acre.

The results obtained are shown hereunder:—

#### MULCHING EXPERIMENT.

Planted on 7th May, 1930.

Variety—Gluyas Early.

Superphosphate—112lbs. per acre.

Seed—30lbs. per acre.

Treatment.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928-30.	Percentage Yields, 1928-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Cultivated in Spring after Summer rains and before seeding	16 16	13 52	14 24	15 12	15 12	14 50	111	15 14	109
Cultivated in Spring and before seeding	12 56	12 48	12 32	14 56	14 32	13 33	100	13 56	100
Cultivated before seeding only	13 36	13 44	14 0	14 8	15 12	14 8	104	14 7	101

This year's results and the average results for three years indicate that higher yields are obtainable when the fallow is cultivated after rain during spring and summer months.

#### Nitrogen Experiment, 1930.

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of sulphate of ammonia are applied to the wheat crop in addition to an application of superphosphate.

For the purpose of the experiment, two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwt. respectively, while a third plot which received no sulphate of ammonia was used as a control plot. Superphosphate was applied at the rate of 112 lbs. per acre to all plots, which were repeated five times.

The experiment is slightly modified this year, as it is planted on fallowed as well as unfallowed land.

The fallow section was ploughed with a disc implement in June, 1929, and was springtyne cultivated in September and prior to seeding.

The unfallowed land was ploughed to a depth of 3 ins. in April and springtyne cultivated immediately before seeding.

The experiment was planted on 9th May, the variety Gluyas Early being sown at the rate of 30 lbs. per acre and superphosphate applied to all plots at the rate of 112 lbs. per acre.

The results obtained are tabulated hereunder:—

#### NITROGEN EXPERIMENT.

##### Non-Fallow Section.

Planted on 9th May, 1930.

Variety—Gluyas Early.

Superphosphate—112lbs. per acre.

Seed—30lbs. per acre.

Rate of Application of Sulphate of Ammonia per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
112lb. ... ..	13 44	11 44	12 0	13 4	12 56	12 42	97
Nil ... ..	13 20	12 32	13 4	12 48	13 28	13 2	100
224lb. ... ..	11 44	10 56	12 32	11 36	12 32	11 52	91

*Fallow Section.*

Planted on 9th May, 1930.

Variety—Gluyas Early.

Superphosphate 112lbs. per acre.

Seed—30lbs. per acre.

Rate of Application of Sulphate of Ammonia per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
112lb. ... ..	bus. lbs. 19 36	bus. lbs. 19 20	bus. lbs. 17 12	bus. lbs. 18 24	bus. lbs. 16 24	bus. lbs. 18 11	% 106
Nil ... ..	16 24	18 0	17 20	17 28	16 56	17 14	100
224lb. ... ..	20 32	16 24	18 32	18 24	15 12	17 49	103

The experiment has been conducted on fallowed land for two years and on the unfallowed land once, so that, as yet, no definite conclusions can be arrived at

The results show that on the plots where sulphate of ammonia was applied in addition to superphosphate, the yields obtained from the unfallowed section were lower than when only superphosphate was applied. These results were reversed from the fallowed section. In both sections, the plots receiving dressings of 1 cwt. of sulphate of ammonia gave higher yields than those receiving double this dressing.

**FIELD EXPERIMENTS WITH WHEAT, 1930.****DAMPAWAH EXPERIMENT FARM.**

I. THOMAS, Superintendent of Wheat Farms,  
and  
F. GISHUBL, Farm Manager.

The following experiments were conducted at the Dampawah Experiment Farm during 1930, in addition to those published in the March issue of the *Journal*:—

Fallow and Non-Fallow.

Time of Ploughing.

Depth of Ploughing.

Mulching.

Nitrogen.

The farm is situated 30 miles East of Perenjori, being formerly a portion of Karara Station, on the fringe of the Lower Murchison.

The soil is a red friable loam, uniform in appearance, and was originally timbered mainly with york gum, giant mallee, karara, and mulga scrub.

This is the first crop grown on this land, which was cleared during 1928 and the early part of 1929. After the burn a large quantity of ashes remained over the whole area. It was ploughed during the winter months (July-August) of 1929, with a disc cultivating plough 3-4 inches deep. Immediately after

ploughing it was cultivated with a springtyne implement. The seed was planted with a combined cultivator drill at the rate of 45 lbs. per acre. Superphosphate was applied at 112 lbs. per acre.

The following table shows the rainfall registered at the farm since it was established, together with the number of days on which rain fell during the year under review.

Year.	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for Year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1928 ... ..	*	*	*	*	164	94	238	142	71	34	743	6	156	+
1929 ... ..	17	220	64	Ni	267	234	60	62	18	33	674	120	—	1,095
1930 ... ..	—	—	93	123	48	404	160	93	22	41	768	31	54	1,069
No. of falls, 1930 ...	—	—	8	9	2	16	12	10	2	3	45	5	3	68

\* No records.

+ Incomplete.

Although the rainfall during the growing period this year was greater than the previous year, the spring rains were somewhat similar, being scanty and insufficient for the crops to mature normally.

After a very dry period from the middle of November, 1929, 93 points of rain were recorded in March, spread over 8 days. Both before and after this rain hot dry weather conditions prevailed.

Prior to the middle of April, when 123 points of rain were recorded, no moisture could be detected in the subsoil as the rain which fell the previous month evaporated very rapidly. The registrations during the month of May were scanty and caused anxiety, as some of the crops already sown were above ground, and showed signs of distress and urgent need of rain.

The continuous and copious rains during June relieved the position, reviving patches of the crop on which the seed had appeared to have malted. There were, however, isolated patches which were affected by the seed malting.

Excellent growing conditions prevailed throughout July and the early part of August, and until the end of the third week of the latter month the crops looked very promising. Unfortunately the seasonable rains terminated abruptly at this time, resulting in the ears of the plants being unable to leave the sheath normally or wilting before reaching maturity. Harvesting of the crops for hay was commenced 16th September, and for grain on 23rd October.

#### *Fallow and Non-Fallow Experiment, 1930.*

The object of this experiment is to ascertain the effect upon the resulting wheat crop of sowing on fallowed and unfallowed land.

For the purpose of the experiment two sets of plots were required. The fallow plots were ploughed on 27th June, 1929, and were springtyne cultivated in September and prior to seeding. The unfallowed plots were ploughed on 14th April, 1930, and springtyne cultivated prior to seeding.

The plots, which were each one-eighth of an acre in area, were repeated five times.

The variety Gluyas Early was sown on 2nd May at the rate of 45 lbs. per acre, superphosphate being applied at the rate of 112 lbs. per acre.

The results are as hereunder:—

#### FALLOW V. NON-FALLOW EXPERIMENT.

Planted on 2nd May, 1930.

Variety—Gluyas Early.

Superphosphate—112lbs. per acre.

Seed—45lbs. per acre.

Treatment.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
Fallow ... ..	bus. lbs. 9 52	bus. lbs. 11 52	bus. lbs. 12 0	bus. lbs. 11 44	bus. lbs. 12 40	bus. lbs. 11 38	% 100
Non-Fallow ... ..	9 12	10 0	10 48	10 8	10 8	10 3	85

As this is the first year that the experiment has been conducted at this farm, no definite conclusion can be arrived at. They indicate, however, that increased yields are obtained from fallowed land.

#### Time of Ploughing Experiment, 1930.

The object of this experiment is to ascertain whether the time of carrying out the initial operation of fallowing, *i.e.* ploughing, has any effect upon the yield of the resultant wheat crop.

For the purpose of the experiment three plots were required:—

Plot 1. Ploughed in April.

Plot 2. Ploughed in June.

Plot 3. Ploughed in August.

All plots were repeated five times.

Subsequent to ploughing, all plots were springtyne cultivated in September and prior to seeding, which took place on 2nd May. The variety Gluyas Early was sown at the rate of 45 lbs. per acre and superphosphate applied at 112 lbs. per acre.

The results obtained are as follow:—

#### TIME OF PLOUGHING EXPERIMENT.

Planted on 2nd May, 1930.

Variety—Gluyas Early.

Superphosphate—112lbs. per acre.

Seed—45lbs. per acre.

Time of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
April, 1929 ... ..	13 52	12 8	13 12	12 8	14 48	13 13	98
June, 1929 ... ..	13 36	13 44	13 4	12 48	14 32	13 33	100
August, 1929 ... ..	12 8	11 52	12 24	13 12	12 8	12 21	91

From these results, which are for one year only, it would appear that the yields are increased when the land is ploughed during the early winter months and are in conformity with the results of somewhat similar experiments conducted at the other experiment farms.



### *Depth of Ploughing Experiment, 1930.*

The object of this experiment, which was conducted for the first time last season, is to determine the comparative effects upon the resultant crop of ploughing the land to different depths.

For the purpose of the experiment three plots were required, and they were ploughed in July, 1929, at the respective depths of 2 inches, 4 inches and 6 inches, the whole experiment being repeated five times. The plots were spring-tyne cultivated in September and prior to seeding, which took place on 3rd May, the variety Gluyas Early being planted at the rate of 45 lbs. per acre and superphosphate applied at the rate of 112 lbs. per acre.

The results obtained were as follow:—

#### DEPTH OF PLOUGHING EXPERIMENT.

Planted on 3rd May, 1930.

Variety—Gluyas Early.

Superphosphate—112 lbs. per acre.

Seed—45 lbs. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
2in. deep ...	14 8	9 36	11 28	11 36	10 40	11 30	93
4in. „ ...	13 44	12 32	11 28	12 8	11 36	12 18	100
6in. „ ...	13 4	12 48	12 16	11 28	10 48	12 5	98

As the experiment has been conducted for one year only, no definite conclusion can be stated, but the results agree with those of a similar experiment conducted at other experiment farms, which are that the most economical depth to plough is 4 inches.

### *Mulching Experiment, 1930.*

This experiment is conducted in order to determine to what extent the cultivation of winter fallowed land is profitable during the spring and summer months.

Three plots were necessary to fulfil the requirements of the experiment. They were treated as follows:—

Plot 1.—Cultivated prior to seeding only (neglected fallow).

Plot 2.—Cultivated during spring and prior to seeding only (ordinary fallow).

Plot 3.—Cultivated during spring, again when required during summer after 25 points of rain or over, and again prior to seeding, the object being to maintain a mulch throughout the fallowed period and to destroy weed growth.

The soil on which the experiment was conducted was a red friable loam, the original timber being york gum and karara. This land was fallowed and cropped for the first time for this experiment.

All the plots were ploughed during July, 1929, and subsequently received the following cultivations with a springtyne implement.

Plot 1.—Cultivated before seeding only.

Plot 2.—Cultivated in September and before seeding.

Plot 3.—Cultivated in September, October, November, March, and prior to seeding in May.

The results obtained this season are as follow :—

#### MULCHING EXPERIMENT.

Planted on 5th May, 1930.

Variety—Gluyas Early.  
Seed—45lbs. per acre.

Superphosphate—112lbs. per acre.

Treatment.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1929-30.	Per-centage Yields, 1929-30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Cultivated before seeding only	10 40	8 32	11 4	10 56	11 36	10 34	104	16 17	102
Cultivated in Spring and before seeding	11 12	8 40	10 16	10 48	9 44	10 8	100	16 2	100
Cultivated in Spring during Summer after rain and before seeding	9 4	11 4	9 20	10 16	8 0	9 33	94	15 19	96

Although Plot No. 3 received three additional workings the results are no better than those from the plot worked after ploughing and before seeding only. However, the results are only for two years and cannot as yet be accepted as conclusive.

#### Nitrogen Experiment, 1930.

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of nitrogenous fertiliser are applied to the wheat crop, in addition to an application of superphosphate.

For the purpose of the experiment two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwt. respectively.

Superphosphate was applied to all plots at the rate of 120 lbs. per acre and those plots, to which superphosphate only was applied, were treated as controls. Comparisons were made between these control plots and those receiving 1 cwt. and 2 cwt. of sulphate of ammonia respectively. The fertilisers were applied at seeding time. The plots were repeated five times, the whole experiment being sown on fallowed and unfallowed land.

The fallowed section was ploughed during June and July, 1929, to a depth of 4 inches and was cultivated with a springtyne cultivator in September and received no further cultivation, the experiment being planted with a combined cultivator drill.

The unfallowed section was ploughed 3-4 inches deep with a disc implement on 7th April, 1930, and received no further working until seeding, when it was planted with a combined cultivator drill.

The results obtained are shown hereunder :—

#### EXPERIMENT FARM, PERENJORI.

#### NITROGEN EXPERIMENT.

##### Fallow Section.

Planted on 9th May, 1930.

Variety—Gluyas Early.  
Seed—45lbs. per acre.

Superphosphate—120lbs. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
112lbs. ... ..	7 52	7 52	7 30	7 4	6 0	7 17	91
Nil ... ..	7 20	8 24	8 32	8 10	7 20	7 58	100
224lbs. ... ..	6 32	6 48	6 24	4 56	4 40	5 52	74

*Non-Fallow Section.*

Planted on 9th May, 1930.

Variety—Gluyas Early.

Superphosphate—120lbs. per acre.

Seed—45lbs. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
112lbs. ... ..	bus. lbs. 5 20	bus. lbs. 6 56	bus. lbs. 5 52	bus. lbs. 6 32	bus. lbs. 6 8	bus. lbs. 6 10	% 84
Nil ... ..	6 56	7 20	8 32	7 12	6 32	7 18	100
224lbs. ... ..	5 4	4 8	5 20	5 28	5 36	5 7	70

These results which are for two years in the case of the fallow section, and one year in the non-fallow section, indicate that no advantage is obtained by the application of a nitrogenous fertiliser to either fallowed or unfallowed land.

## “DOWNY MILDEW” (SO-CALLED “BLUE MOULD”) OF TOBACCO.

### THE INDUSTRY'S MOST SERIOUS MENACE, AND HOW TO COMBAT IT.

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The disease known as “Downy Mildew,” or more frequently, although less desirably, “blue mould” of tobacco, is the most disastrous disease with which the Australian tobacco-grower has to contend, wiping out, as it does with monotonous regularity year after year in the Eastern States, enormous numbers of plants in the seed-beds, and sometimes even after planting out.

The extremely serious nature of the trouble under favourable conditions may perhaps be best realised from the following quotations. In the “Report from the Select Committee on the Tobacco-growing Industry in Australia,” 1929-30 (9), occurs the statement: “The growers have hitherto proved unable to deal with the blue mould disease, which in many cases wipes out the tobacco of a whole district two out of three seasons.” Adam (1), writing in the Victorian Journal of Agriculture for July, 1925, stated: “Frequently a tobacco seed-bed, containing thousands of plants in a condition ready for planting out, is ravaged to such an extent that every plant is affected. Growers, in the past, by cultivating a large number of seed beds in different parts, especially in the hills, sought to avoid disease in some beds, and usually from these sufficient plants could be obtained for planting-out purposes. A more serious problem has arisen lately in that the disease is not confined to the seed-bed, and quite large areas of planted-out tobacco in various stages of maturity have been ruined by it.”

Tobacco-growing is still in its infancy in Western Australia, but already we have experienced one disastrous outbreak of the disease. This was at Manjimup last year on two adjoining properties (6). On both of them the disease was the cause of very poor financial results being returned to the growers. It is with the object of preventing, if possible, similar disasters this year, when hundreds of persons in widely-scattered parts of the State will be planting tobacco for experimental purposes, that the present article is being written.

## CHARACTERISTICS OF THE DISEASE.

As shown by Darnell-Smith (4), a tobacco seedling may be infected in the very earliest stages, *i.e.*, when it has not yet developed its first true leaves, but is still in the "cotyledon" or "seed-leaf" condition. From that time onwards, right throughout its life, it may fall a prey to the disease whenever the weather conditions become suitable to the development of the fungus and the plant happens to be in a susceptible condition, provided always that the fungus concerned (*Peronospora sp.*) is present in the correct condition to cause infection. (Many farmers and others appear to have the idea that "downy mildew" ("blue mould") of tobacco can develop spontaneously out of nothing, as soon as the weather conditions become suitable. This is most definitely not so. The "blue mould" disease can only develop if some stage of the "blue mould" fungus (*Peronospora sp.*) is already present in the environment when the weather or atmospheric conditions become suitable. The "blue mould" fungus can only be begotten by the "blue mould" fungus, just as, for example, sheep can only be begotten by sheep, or tobacco plants by previous tobacco plants.)

For an outbreak of the "downy mildew" ("blue mould") disease of tobacco three requirements are absolutely necessary, as follows:—

- (i) The correct fungus (*Peronospora sp.*) must be present.
- (ii) The weather or atmospheric conditions must be suitable for infection.
- (iii) The tobacco plants must be in a susceptible condition.

If any one of these requirements is not satisfied the disease cannot develop. Thus, if the temperature and humidity conditions in the seed-beds were maintained unfavourable to infection, the plants could be bombarded with the spores ("seeds") of the causal fungus without the disease developing.

In actual practice "downy mildew" or "blue mould" of tobacco is, in most instances, very largely a seed-bed disease, although—as shown above—it may at times cause very severe losses after the seedlings have been planted out. The causal fungus (*Peronospora sp.*) is a member of the rather primitive group of fungi known as the *Peronosporales*, to which also belongs *Phytophthora infestans*, the cause of "Irish Blight" of the potato. All these fungi require abundance of moisture for their best development, and so it is only under the abnormally moist atmospheric conditions of the seed-bed that the disease is likely to be of much consequence in Western Australia. The "downy mildew" of tobacco appears to require very similar conditions to those required by "Irish Blight" for its rapid and serious development, namely, warm, muggy conditions during the day and rather cold air temperatures at night, or fairly rapid alternations of muggy and cold weather. As, therefore, the climatic conditions in the South-Western area of this State are only very occasionally favourable to "Irish Blight," it would seem reasonable to suppose the same would apply to "downy mildew" of tobacco once the seedlings had been planted out. If Western Australian growers can manage to get their seedlings through the seed-bed stage they should experience very little trouble with the disease in the field under normal climatic conditions.

## SYMPTOMS SHOWN BY DISEASED PLANTS.

The most characteristic feature of affected plants is the development of a dense, white or greyish down on the *underneath* portions of the diseased leaves. This downy substance is really composed of the fruiting-branches of the fungus loaded with the microscopic lemon-shaped or oval seed-bodies or spores. Under the microscope the fruiting structures (*conidiophores*) bear a rather striking resemblance to a dead, but still standing, karri tree, the spores being produced singly

at the extremities of the many-forked branches. Under a strong hand-lens the mildew appears like a mass of densely tangled whitish scrub (Fig. 1b). (The name "blue mould" was given to the disease on account of a very faint violet tint occasionally distinguishable in the fungal down, but the name does not seem to me at all appropriate, as, so far as my observation goes, the least conspicuous feature of the fungus is its supposed blueness. The name has the further disadvantage of immediately calling to mind the well-known "blue moulds" of fruit and other edible products commonly caused by species of *Penicillium*, to which the *Peronospora* of tobacco has only a distant relationship.)

Looked at from above, affected leaves show no evidence of the "downy mildew" itself, but the diseased plants can usually be picked out by the occurrence of irregular yellow blotches on the leaves, or by the drying-out and shrivelling-up of the diseased areas (Fig. 1a). Affected leaves are often a more or less uniform pale yellow in colour when looked at from above. Under conditions very favourable to the fungus the whole plant may soon wither up and completely collapse, but, should unfavourable conditions for the fungus ensue before this occurs, the plant may recover more or less completely until conditions are once again favourable for the further development of the parasite, when the disease may make further headway until perhaps checked yet again by unfavourable conditions. Darnell-Smith (4) records that a plant once infected is always a potential source of infection; "for example, an infected plant kept in an isolated bush house produced a crop of spores in November, another crop in the following March, and a third crop in the following November." On the occurrence of the Manjimup outbreak it was found that infection of the seedlings had almost certainly been brought about by the blowing of *conidia* (spores) from over-wintering diseased plants (6). These old plants on being examined were found in a number of cases to have several dead brown areas on a number of the bottom leaves. On the underneath surfaces of the dead tissues were found large numbers of the typical *Peronospora* conidiophores.



Fig. 1. a. (left) A young tobacco plant infected with "downy mildew" ("blue mould"). Note the shrivelling of the leaves indicated by the arrows.

b. (right). Portion of the underneath side of a young leaf infected with "downy mildew" ("blue mould"). Note the whitish, downy, growth of the fruiting-bodies of the causal fungus, *Peronospora* sp. (Magnified). After N.S. Wales Dept. of Agriculture.

In addition to occurring on the cultivated tobacco, "downy mildew" or "blue mould" has been also recorded on a species of native tobacco (*Nicotiana suaveolens*) (1, 4). Darnell-Smith (4) reports that a *Nicotiana* closely related to *N.*

*suaveolens* obtained from Lord Howe Island was found to be liable to infection. *Solanum pseudo-capsicum* (Jerusalem Cherry) and *Solanum sodomaeum* (Apple of Sodom) gave negative results (4).



Fig. 2.—Adult tobacco leaf showing holes in places previously attacked by “downy mildew” (“blue mould”) due to *Peronospora* sp. After N.S. Wales Dept. of Agriculture.

### LIFE HISTORY OF THE FUNGUS.

In spite of the fact that “blue mould” has long been a serious disease in the Eastern States and that numerous short articles on the disease have appeared from time to time in the various Agricultural Journals and elsewhere, there has apparently never been any very intensive laboratory study made of the disease, and so there are many points on which our knowledge is surprisingly meagre.

For instance, it is known that the fungus responsible for the disease may produce thick-walled resting spores in the dead tissues known as *oospores* (1), which may retain their vitality for long periods, but in what numbers they are normally produced or just how important may be their role in nature in carrying the disease over from season to season is unknown.

Another rather surprising feature is that there is very little *exact* data as to the particular climatic conditions under which epidemics of the disease occur. In this connection Darnell-Smith (5) states, “It makes its appearance particularly when the rainfall is excessive” and “a particular relationship must exist between the weather, the plant attacked, and the fungus before the latter can establish itself and spread with rapidity.” Just what this relationship is, is not stated. Adam (1) in 1925 wrote, “There is a close connection between climatic conditions and the incidence of ‘blue mould’ disease. Data in respect of temperature, humidity, and rainfall have been collected at Wahgunyah Experiment Farm and at Buffalo River. . . . This data, with notes on the disease obtained from year to year, will acquire more interest with the passage of time, but nothing useful can be gained from their presentation here.” Mr. Temple A. J. Smith, Tobacco Expert of the Victorian Department of Agriculture, writing on “blue mould” in 1911, stated: “It is worse in or after wet seasons when the first warmth of spring is felt. (Rusty seasons for wheat are generally bad for blue mould.)” (7).

*Conidia* of the “blue mould” fungus apparently only remain viable for a few days. Adam (1), for example, states, “From its structure the oospore, or resting spore, is able to retain its vitality for quite long periods. In this regard it is distinct from the short-lived conidia, or summer spores, previously mentioned as constituting part of the familiar violet downy patches characteristic of the disease.”

In connection with the phenomena of *infection* Darnell-Smith (4) writes—  
“It has been observed (in numerous infection experiments carried out with the spores of blue mould):—

1. That the spores germinate, under suitable conditions, within twenty-four hours.
2. That they produce a strong germ tube which enters by the leaf pores.
3. That, having entered the leaf, a large number of hyphae are produced in the tissues.
4. That, within eight or nine days, a fresh crop of spores may be produced from the infected leaf.
5. That a tobacco plant in its very youngest stages may become infected with ‘blue mould.’”

Angell (3) implies in the following statement that under normal conditions the conidia live, at the most, only a few days, “. . . we have found that . . . under certain conditions of temperature and humidity the detached conidia of the blue mould fungus may remain viable for, and germinate after, 54 hours or more. . . .”

The same writer further states (3) that in certain experiments “the usual period of seven days required for infection was in this case, as well as in others which have come under our notice, reduced to four days, this being apparently due to the very favourable conditions of temperature (23 deg. C.) (equalling 73.4 deg. F.) and humidity under which the seedlings were kept and more especially perhaps to their extreme susceptibility at that age.” “The seedlings used had germinated five to seven days before the experiment was carried out. . . .”

It would seem then that the optimum temperature for infection by the “downy mildew” lies somewhere in the vicinity of 73 deg. F.

On the other hand, in “The Farmers’ Handbook,” 5th edition, published in 1929 by the New South Wales Department of Agriculture, it is stated, “Experiments conducted by the department during the last few years indicate that if the temperature of the seedlings is not allowed to fall below 45 deg. F. and the surrounding air is not allowed to become humid, blue mould does not make its appearance.”

We may conclude then that the conditions favouring the most rapid development and spread of the “downy mildew” or “blue mould” disease of tobacco are warm, muggy conditions during the day with low temperatures at night, or else warm, muggy periods alternating with cold ones. These conditions are similar to those required for epidemics of “Irish blight” in potatoes and various other “downy mildew” diseases of plants.

#### PRECAUTIONS TO BE TAKEN TO PREVENT THE DEVELOPMENT OF “DOWNY MILDEW” (“BLUE MOULD”) OF TOBACCO.

The writer firmly believes that “downy mildew” (“blue mould”) of tobacco can be prevented, or at least “controlled,” in Western Australia, provided that the proper precautions, as indicated below, are taken.

In this connection no single measure can be relied on for success. Control of such a serious pest as the “blue mould” can only be achieved by the intelligent combination of a series of interdependent practices. These may be stated as follows:—

I. At the conclusion of the harvesting operations for the season, *i.e.*, when all the seed or leaf has been gathered, every tobacco plant on the property should be destroyed, in order to prevent carrying the fungus over from year to year on

over-wintering plants. The best method of destruction would be to pull up the remains of the plants by the roots and burn them, but, if the same field is not to be used again for several years for tobacco-growing, there would be no objection to ploughing the plants under, provided that a mouldboard plough which will completely bury the tissues is used and that any suckers which may happen to grow up are systematically destroyed as soon as noticeable above the ground. Tobacco growers should regard tobacco plants growing on their properties at any other times than when being deliberately grown for seed or leaf as their worst possible enemies, from the point of view of insect and disease dissemination.

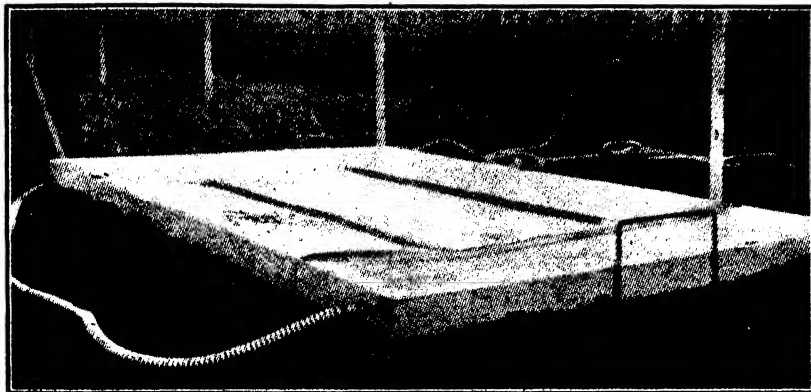


Fig. 3.—Showing a method of sterilising soil by steam, using the “inverted pan” system. Note the flexible steam pipe entering the heavy-gauge galvanised iron pan at the front left corner. Note also the handle at the front for lifting the pan from one site to another. The rear handle is hardly obvious in the photograph.—After Chupp, “Manual of Vegetable Garden Diseases.”

Ministerial approval under the Plant Diseases Act, 1914/25, has been obtained to enable the above operation to be rigorously enforced by the end of June at the very latest. The importance of this step will be realised when it is remembered that the only outbreak in the seed beds we have so far experienced in Western Australia was almost certainly due to infection from diseased suckers found growing near by. (6).

II. The seed beds should be placed in a new position each year, and should be as far as possible removed from curing-barns, or places in which tobacco is stored, or fields which have previously grown tobacco.

III. The seed beds should be *sterilised* in one or other of the following ways:—

- (a) by the use of steam at 100 lbs. pressure for half an hour by means of the “inverted pan” system; or
- (b) by the use of a strong wood fire on the site of the seed bed for at least four hours. (The heat should be sufficient to cook a 4oz. potato buried three inches deep in the soil, or an egg buried five inches deep.)\* Or

\* N. A. R. Pollock, “Tobacco Seed Beds,” Queensland Agri. Journal,” Vol. 34, Part 4, pp. 408-412, October, 1930.



- (c) by thoroughly loosening the soil of the seed bed with a spade, etc., and then watering with *formalin solution* made up at the rate of one gallon of commercial formalin to every fifty gallons of water, using half to one and a half gallons of the made-up solution to every square foot of soil. Formalin-moistened bags, or the glass frames or linen covers after being watered with, or dipped in, the formalin solution, should be put on the beds for two days following treatment to hold in the fumes, then removed and the beds stirred and allowed to air for at least 10 days before sowing the seed. When stirring the beds to let out the formalin fumes, after the first two days, or to make a suitable surface on the bed to receive the seed at the completion of the treatment, use a rake or shovel, etc., previously sterilised with steam, fire or formalin.

IV. All seed sown should be soaked before sowing in absolute alcohol for five minutes to destroy any infection possibly being carried by the seed.

*The Department has undertaken to treat all tobacco seed at a cost of one shilling per ounce or part thereof, and, under the Plant Diseases Act 1914, the sale or distribution of tobacco seed within the State has been prohibited, unless, and until, the seed has first been disinfected under the supervision of an Inspector under the Act. Under the same Act steps have been taken to have the importation of tobacco seed from other States or Overseas prohibited except for Departmental purposes (see Government Gazette 24th October, 1930). The penalty for disregarding any regulations under the Act is £25.*

Disinfection of the seed in absolute alcohol has recently been shown by Angell (2) to be very effective, and this treatment must be considered henceforth a routine practice in tobacco culture. (Departmental experiments have shown that the germination of the seed is not detrimentally affected by as long an immersion as six and one half minutes in absolute alcohol, if the seed is spread out thinly and dried on clean blotting paper, with frequent turning to hasten the evaporation of the alcohol, as quickly as possible following treatment.)

V. Seeing that the "downy mildew" or "blue mould" is greatly encouraged by abundance of moisture, every precaution should be taken to keep the surface of the seed-bed as *dry* as possible after the seeds have germinated. Every effort should be made to reduce the surface waterings to an absolute minimum or even to eliminate them altogether. This may be done by making the soil very firm during the preparation of the seed-bed so that water will readily flow to the roots by capillarity, or by watering, as in the "Marks" system (9), from a trough running along the back of the seed-bed with perforated pipes at right angles carrying the water several inches below the surface of the soil. Another good method of watering is to have agricultural drain tiles placed upright at intervals through the seed-bed, so that the water may be poured down into the sub-surface layers of the bed without directly wetting the surface or the leaves of the seedlings. Seed-beds should have a pronounced slope from the back to the front and should be so built as to lie broadside-on to the morning sun. As soon as the seeds have germinated they could be lightly covered with sterilised white sand, and a little of the sterilised sand could be sprinkled on the bed from time to time as the seedlings grow older. The sand could be sterilised by heating in shallow tins in an oven for several hours, and it could then be stored in sterilised kerosene tins until required.

VI. The glass frames, or the linen or hessian covers to the seed-beds, should be removed every bright, dry, sunny day so as to cause hardening-up of the seedlings and prevent the steamy conditions so favourable to the "downy mildew."

VII. If possible some source of heat should be provided for the seed-beds at night, and during cold days, so as to prevent the temperatures dropping below 45deg. F., as the development of the fruiting-bodies of the fungus (and consequently its rapid spread) seems to be greatly favoured by low temperatures following warm, muggy, conditions just previously. Some growers make use of a fire with a straight-through or return flue *beneath the bed* to keep up the temperatures, while others use a kerosene- or petrol-lamp outside one end of the bed to heat a pipe running through the frames *above* the seedlings. This would seem to be the best type, as tending to lower the humidity of the air above the bed quite considerably, but care must be taken to see that the apparatus cannot get too hot. Moreover, if this method is used, the covers to the seed-beds must be erected considerably further above the surface of the beds than is common practice at the present time.

In "The Farmers' Handbook," 5th edition, published in 1929 by the New South Wales Department of Agriculture, it is stated: "**Experiments conducted by the department during the last few years indicate that if the temperature of the seedlings is not allowed to fall below 45deg. F. and the surrounding air is not allowed to become humid, blue mould does not make its appearance**" (8).

VIII. Seed-beds should be made long and narrow, and not short and broad. About a yard wide should be ample. This type of construction greatly facilitates the work of weeding, transplanting, etc., and there is not nearly so much chance of spreading infection mechanically during inspection of the seedlings.

IX. Seedlings should be lightly dusted every seven days or so, particularly on the *underneath* sides of the leaves, with a recognised copper carbonate-sulphur dust such as "Azurine No. 4," or a copper-lime dust such as "Bordo No. 2." This can be fairly readily applied by the use of a "sulphur bellows" provided with a straight nozzle. The bellows should be held several inches above the seed-bed at the handles and pointed forward and slightly down, so that a cloud of dust will hit the earth at a very acute angle and in glancing off and rising will come in contact with the bottom sides of the leaves. Moderation must be used in the application of the dust, and care must be taken to remove the frames whenever the sunlight becomes very hot following the treatment, or considerable "sulphur scorching" of the foliage may result from any dust containing sulphur.

X. Seed-beds should be planted as *late* as possible in the spring, as the lower the atmospheric humidity during the growth of the seedlings and following transplanting the less is the danger of loss from "downy mildew." Considerably more seedlings should be raised than are actually required for planting out, and a succession of sowings in different seed-beds at weekly or fortnightly intervals may be of considerable value in ensuring that some at least will come through to planting-out time unscathed.

XI. If possible, tobacco should not be grown more frequently than, say, once in three years on the same paddocks, as the fungus, in the resting-spore (*oospore*) stage, can apparently remain alive in the soil for a long period.

XII. In the event of "downy mildew" breaking out in the field, the plants should be sprayed with Bordeaux Mixture 3-3-50 plus  $\frac{1}{2}$  lb. calcium caseinate to every 50 gallons of spray, taking great care to see that the bottom sides of the leaves are thoroughly sprayed. (Preparation of Bordeaux Mixture is fully described in Leaflet No. 314, available, free of charge, on application.) Instead of spraying, the plants could be dusted with a recognised copper carbonate-sulphur or copper sulphate-lime dust, although after planting-out spraying will be found more effective than dusting.

XIII. Should any plants in the seed-beds become affected with "downy mildew," they, and the immediately-surrounding plants, should be destroyed *before*

removing from the bed by watering with a little strong bluestone solution made up at the rate of 1 lb. to 1 gallon of water. After the plants are dead, or thoroughly wet with the bluestone on the bottom sides of the leaves, they should be removed and burned, or deeply buried.

XIV. All precautions should be taken to keep down insect pests, as these are very liable to carry infection into the bed from neighbouring farms or from plant to plant in the beds. Angell (3) has recently shown that the "potato moth" or "tobacco leaf miner" (*Phthorimaea operculella*, Zell.) can readily carry infection, and the same undoubtedly applies to other insects such as the Lucerne Flea (*Smynturus viridis*, Linn.) or the Red-legged Earth Mite (*Penthaeus destructor*, Jack.), etc.

A space free of all vegetation should be left for several yards around the tobacco beds as this will act as a good break to the lucerne flea, mite, and other similar walking or hopping insects.

XV. Growers should refrain from visiting other growers' seed-beds, as one careless human might carry considerably greater numbers of fungus seeds (*spores*), and for much greater distances, than many insects.

XVI. All "native tobacco" plants (*Nicotiana suaveolens*) or other wild tobacco species on a tobacco plantation, or in a tobacco-growing district, should be periodically destroyed, as they may harbour the "blue mould" fungus. *Nicotiana suaveolens* has definitely been proved liable to infection (1, 4) and, as stated above, Darnell-Smith (4) reports that a *Nicotiana* closely related to *N. suaveolens* obtained from Lord Howe Island was found to be liable to infection.

XVII. Care should be taken to avoid dropping cigarette-ends or fragments of cut leaf from commercial smoking mixtures, especially if air-cured, on the seed-beds of tobacco fields, as it is possible that infection may occasionally be carried in that way.

#### FINAL WORD.

All the above may seem a lot of trouble to go to, but there is no doubt that the successful Australian tobacco-grower of the future will be he who never tires of going to what other people would call trouble, to ensure successful results. The rewards for successful tobacco culture in Australia are very great, but nature certainly seems to be doing her best to ensure that the rewards shall not be too easily won. Biological laws are no less immutable, or less certain in their outcome, however, than physical ones, and he who correctly sets the stage in every detail must inevitably reap the reward.

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## THE NATURAL PASTURES OF WESTERN AUSTRALIA.

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### INTRODUCTION.

The term "Pasture" is one which appears to have no strict definition. The nature of pastures and their composition varies in different countries, and even in districts within a quite small area. As usually understood, pastures are associations of vegetation which are used for grazing animals, in which associations herbage plays a prominent part, and amongst the herbage edible plants, especially grasses, are predominant.

In Australia, pasture has a still wider meaning, and includes country in which grass is present in any quantity, country in which both herbage and edible tree-growths occur, and country which carries little or no grass but in which the shrubs themselves constitute the forage. Such are the natural pastures of Australia, in which the farmer or stock owner has done nothing to create, and which he does but little to maintain. The improvement and management of these is largely a question of the regulation of the carrying capacity, the principal danger being one of injudicious stocking.

Artificial pastures, on the other hand, are pastures laid down by man, suitable plants being laid down and maintained for the purpose of providing forage for stock. They are temporary or permanent according to the climatic or soil conditions, the nature of the constituent plants, or the requirements of the owner.

Pastures are therefore (a) natural or artificial, and (b) permanent or temporary. They are primarily governed by the factors of climate and soil, the former being the more important.

Western Australia may be divided into three climatic zones: (i) a northern tropical area which experiences reliable periodic rains which fall in the summer, the cooler season being dry; (ii) a southern temperate area of definite winter rainfall alternating with a dry summer; and (iii) an intermediate zone which is essentially a region of summer rainfall, but in which the precipitations are highly intermittent and altogether unreliable. Each zone is again capable of climatic division, but this subdivision most closely affects artificial pastures, and will be dealt with subsequently.

Permanent natural pastures are confined to the northern area where summer rains prevail. These pastures are essentially Grasslands, and assume three forms according to climatic or soil types. We may thus recognise typical Grasslands in the Kimberleys on the black soil plains where the rich alluvium brought down by the rivers, and the warm climate produce extensive tracts of tussocky and other grasses in close formation to the exclusion of all else except such other herbaceous growth as is able to successfully compete with them. The richer basaltic flats furnish another example of the same formation. Then there is the *Steppe* formation, consisting of harsher grasses which are necessitated by the drier nature of the soil or extreme climatic conditions. Steppes are found in their typical form in Russia and in the Prairies of America, and in both cases continental climates prevail. Their counterpart in Australia is found in the tussocky country of the Pilbarra District and the drier regions of Kimberley, and in a still more extreme form in the *Spinifex* country of the arid interior. The third type is known as *Savannah*. This is grassland carrying scattered trees.

The intermediate zone, with its unreliable rainfall, carries *Spinifex* country, alkali flats with clay pans and the so-called "salt lakes," and a peculiar type of savannah known as "Mulga Bush." The term "Mulga" embraces a number of species of *Acacia* characterised by stiff greyish "leaves" and usually an umbrella-like habit of growth, and large areas are given over almost exclusively to the Mulga bushes with their herbaceous undergrowth and small scattered shrubs amongst which saltbushes are not uncommon. Indeed, so typical is Mulga of the area in question, that it may be referred to as the "Mulga zone." The constituents of the undergrowth vary considerably, temporary (annual) grasses and other herbaceous forage plants occurring in varying quantities, mixed with some tussocky grasses including *Spinifex*, and edible shrubs. The main herbaceous forage, however, consists of the annual ephemeral plants whose existence is absolutely dependent upon sufficient seasonal rains to ensure their life cycle. When such precipitations fail over two or more seasons the Mulga becomes of importance, providing much of the available forage, and for this reason the Mulga is of outstanding importance in the economy of the Mulga zone.

Further to the south, below the limit of summer rainfall, the *Eucalyptus* country is encountered. Here grassland as a formation fails. This is because the conditions favourable to grassland do not exist. The wet season synchronises with the cold period of the year. This is zone iii—the area of definite winter rainfall. The warm spring rains bring forth an ephemeral growth of grass which disappears with the advent of the hot dry weather. These grasses are usually low in forage value, the exceptions being those species which occur in depressions or other spots which retain some moisture until later on in the season. Grassland cannot occur where high temperatures synchronise with the dry period in countries which have marked wet and dry seasons. Thus the winter rainfall area of Western Australia is remarkably poor in its grass flora, and such grasses as are perennial are either inhabitants of moist locations, or are of a harsh nature and low palatability.

Summarised briefly, therefore, grassland occurs naturally in that portion of the State which receives rain during the summer, and, owing to the reliability of these precipitations in the far north, true grassland exists, whereas in the middle zone, owing to the highly intermittent nature of the rainfall, the only permanent grasses are those characteristic of Steppes, but the appearance of the country is wonderfully changed by the rich ephemeral growth which follows good seasonal rains.

It must furthermore be understood that the limits of seasonal distribution of the rainfall do not follow exact lines. In general it may be said that the Mulga zone is outside the influence of effective winter rainfall, but the limits of summer rainfall are by no means so definite. The tropical monsoonal weather is sometimes accompanied by low-pressure systems which develop off the Pilbarra coast and, as small centres of intense activity, sweep inland in the south-easterly direction, bringing heavy rain. These "Willy Willy" disturbances are, in the main, responsible for the rainfall of the intermediate zone, and although they are as a rule only effective within this zone, they may occasionally become more general and afford bounteous rains to the drier parts of the South-West zone. Thus the country known as the Eastern Goldfields often benefits by these summer visitations, and with the incidence of warm weather, a remarkable growth of native grasses may result. This applies particularly to burnt country, or forest country where the undergrowth is sparse, so that root competition does not hinder to any great extent the development of the grass growth. These perennial grasses do not persist as perennials, but usually die out after the first or second year.

In the South-West the natural pastures are very poor in constitution. Indeed they scarcely justify the term. A few areas, such as the Jam country, or the Tuart country of the west coast, carry a scant growth of annual grass which is eaten in the dried state in the summer in addition to providing spring feed, but except for artificial pastures the capacity of the area would be negligible. The pastures that have been established result from the following:—

(a) *Clearing and grazing only.* Clearing, and the advent of stock, are responsible for the entry of exotic plants.

(b) *Clearing and cultivation,* including the use of superphosphate. This, with stocking, results in the diminution of native plants and the increase of exotic annuals. Superphosphate tends to increase the leguminous constituents.

(c) *The sowing of annual pasture plants,* together with *top-dressing.* Annual artificial pastures.

(d) *The sowing of perennial pasture plants.* Permanent artificial pasture. This is only possible in soil which is moist during the summer. This soil may be naturally moist, or irrigated.

(e) *Swamp pastures.* Land inundated in winter, and available to stock in summer only.

## THE CENTRIFUGAL CREAM SEPARATOR.

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The cream separator is undoubtedly the most essential machine found on dairy farms to-day. Without it the concentration of cream (butter fat) at central factories for the economic manufacture of butter would be almost impossible in this State where dairy farms are scattered, and on its efficiency depends to a great extent the proper utilisation of milk produced on farms. In spite of this, however, one frequently finds this piece of machinery sadly abused. A knowledge, therefore, of the principles on which the cream separator is constructed is of first importance.

In the separation of cream the force utilised is centrifugal force, and in the sense here used, is understood to be that force which causes a body revolving rapidly around a central point, to fly from that centre.

The separation of cream from milk in the centrifugal separator is based on the well known physical law that, when liquids of different specific gravity are rapidly revolved around a common centre, a greater force is exerted on the heavier liquid than on the lighter, causing the heavy liquid to "fly off" or separate furthest away from the centre. Milk consists of two liquids of different specific gravities—the fat particles and the milk serum, and by a suitable mechanism, therefore, may be separated into these two liquids by the utilisation of this force. This principle has been known for centuries and is said to have been utilised by the Chinese for the separation of fruit juices by the simple process of filling gourds with the juices they wish to separate and swinging them rapidly in a circular motion until separation was accomplished. It was not, however, until 1878, that the first continuously operated centrifugal separator was manufactured by Dr. DeLaval for the separation of cream from milk.



FIG. 1.

Courtesy Alfa-Laval Separator Co. Ltd.

Illustration No. 1 shows an ordinary cup in which gravity separation is taking place. A layer of cream is shown at the top, and dots are used to show the rising fat globules.

In Illustration No. 2 the cup of milk is placed on one side of a cream separator bowl. By revolving the bowl at approximately 6,000 revolutions per minute, the cream and skim milk, through the centrifugal force exerted, behave as in Fig. 1, the cream passing to the centre of the bowl while the skim milk, being heavier, is forced to the outside. By boring three holes through the wall of the cup as shown in Fig. 2, the bowl is converted into a crude continuously operated separator. Incoming milk enters the cup at "A," the opening being placed a little below and to the left of the cream line. An opening "B" in the bottom of the cup allows for the escape of skim milk, and finally an opening "C" in the cream layer allows for the cream discharge.

The capacity of such a separator would be limited, its skimming efficiency low, and there would be no means of regulating the thickness of the cream.

It is known that globules of butter fat rise in milk at a speed depending upon the size of the globules and the temperature of the milk. Assuming that this speed is 1 in. in four hours, and that the cup in Illustration 3 is 4 ins. deep, 16 hours will be required for gravity separation to take place, which, however, is never complete, the skim milk containing from .5 to .6 per cent. of butter fat.

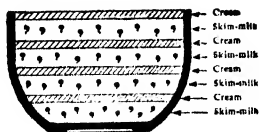
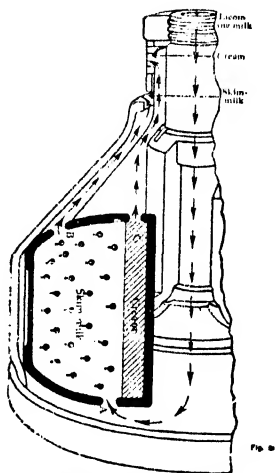


FIG. 3.

Courtesy Alfa-Laval Separator Co. Ltd.

pared with the simple arrangement in Illustration No. 2, as the partitions or discs lessen the period of time required for the centrifugal force to separate the fat globules from the skim milk. In practice the discs divide the milk into very thin

One is familiar with the reasons for the rise of cream to the surface of milk in the gravity setting process, and the same rules may apply to centrifugal separation. The basis of both processes is that the butter fat globules are lighter than the skim milk or serum and rises to the surface of the milk upon standing. Owing to the immense force which may be exerted centrifugally, the separator carries out in seconds what gravity setting cannot carry out in hours. This is illustrated graphically in figures 1 to 4, made available through the courtesy of the Alfa-Laval Separator Co., Ltd.



Courtesy Alfa-Laval Separator Co. Ltd.

Suppose that partitions are placed in the cup so that the milk is divided into four layers each 1 in. thick (See Fig. 3), the fat globules will then have to rise a maximum distance of 1 in. instead of 4 ins., and the setting period therefore will be but one-fourth as long as previously. If these partitions are slanted so that they will lead the layers of cream to the top of the cup, the capacity will have been greatly increased as com-

layers, varying in different makes of separators, but of only several thousandths of an inch in thickness. These discs also enable the whole of the milk to be revolved immediately it enters the bowl.

If a bucket of water is held by the handle, it is possible to rapidly rotate the bucket whilst only the water close to the edge of the bucket will rotate immediately, considerable spinning being required before the water is revolving at the same speed as the bucket. If, however, the water was in very thin layers in the bucket, friction would be sufficiently strong to rotate all the water immediately.

Although placing discs in a separator bowl greatly increases its capacity and efficiency, the actual degree of centrifugal force developed in the bowl depends entirely on the diameter of the bowl and the speed at which it is rotated. As centrifugal force is greatest at the outer edge of the bowl, the thickness of the cream which the machine delivers may be regulated by arranging the cream outlet so that it can be moved to take cream from almost the exact centre of the bowl. All separators have an adjustable screw so arranged that cream may be drawn at different distances from the centre of the bowl, a very slight variation in distance from the centre causing a great difference in the fat content of the cream delivered.

From the foregoing it will be apparent that the cream separator is a delicate piece of apparatus, and in order to maintain its mechanical efficiency should be treated exactly as the various makers prescribe in the booklet always supplied with the machine.

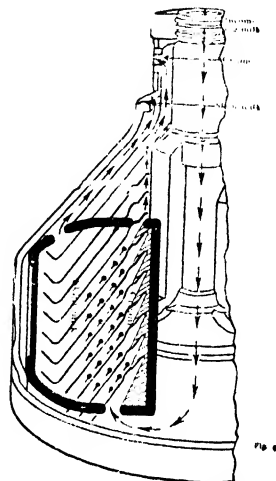
#### CONDITIONS AFFECTING THE SKIMMING EFFICIENCY OF THE SEPARATOR.

Modern separators have a skimming efficiency as high as 98 per cent. of the fat of the milk, and should leave in the skim milk not more than .1 per cent. of fat under normal conditions.

The chief factors which control the skimming efficiency of the cream separator are—speed of machine, rate of milk inflow, temperature of the milk, evenness of running, and cleanliness of separator.

Farmers are advised to test the efficiency of their machine, from time to time, by forwarding a sample of the skim milk to the factory for testing purposes. This is especially important where a large number of cows are being milked.

1. *Speed of Separator.*—The higher the speed the greater is the centrifugal force, and therefore the more complete is the separation. Each machine should be operated at the speed recommended by the makers, as, if the speed is reduced below that required, the skimming efficiency will be lessened. A greater speed than that recommended, however, may not give increased economical separation, and causes undue wear and tear of the machine. The operator, therefore, should time himself by counting the turns of the crank per minute, and by doing this occasionally will soon learn the necessary rapidity of motion required to run the machine at full speed.



Courtesy Alfa-Laval Separator Co. Ltd.



The following table shows the loss of fat in skim milk due to operating the separator at too low a speed, given by Hunziker :—

Skim Milk and Cream.	Speed of Separator.			
	10-15 R.P.M. above normal percentage fat.	Normal percentage fat.	10-15 R.P.M. below normal percentage fat.	20-30 R.P.M. below normal percentage fat.
Skim Milk ... ..	·029	·029	·120	·210
Cream ... ..	32·00	28·50	26·00	23·00

2. *Rate of Inflow.*—The rate of inflow is regulated by means of the float in most hand-separators, the float being contained in a small bowl, and by floating on the milk as the bowl is filled, presses against the tap, preventing a full flow of milk. This rate has a very marked influence on the efficiency of separation. If the rate is increased beyond the capacity of the separator, the skimming efficiency decreases, as the milk passes through the bowl too rapidly to allow the centrifugal force to complete separation. A slower rate of inflow, although not affecting efficiency, is of no advantage. A number of experiments carried out by the Purdu Agricultural Experiment Station illustrate this :—

—	Large inflow.		Normal inflow.		Small inflow.	
	Per cent. of fat.		Per cent. of fat.		Per cent. of fat.	
	Cream.	Skim milk.	Cream.	Skim Milk.	Cream.	Skim milk.
Average of six experiments ... ..	23	·145	29	·028	20	·027

Care, therefore, should always be taken to see that the float is not damaged.

3. *Effective temperature of Milk.*—Efficient skimming is best carried out when the milk is separated at approximately the temperature at which it leaves the animal body, *i.e.*, 95 to 100° Fah. At this temperature the butter fat is still in the liquid form and in a condition for easy separation. Where milk has cooled to 70° Fah. or lower, *i.e.*, feels cold, there is a distinct loss of fat in the skim milk on separation. When milk so cooled is subsequently warmed to 85 to 90° Fah., the fat globules are still largely in a solid state, and the skimming efficiency remains low. In order to bring this back to normal, the milk must be heated above the temperature of the melting point of butter fat, *i.e.*, about 100° Fah., and held there sufficiently long to permit the fat to melt.

4. *Smoothness of Running.*—Not infrequently separators are noticed screwed to tables or other objects not firmly embedded in the floor, causing vibration when the separator is turned. The trembling of the machine may cause portion of the cream and skim milk to again become mixed, causing a relatively large amount of butter fat to be lost with the skim milk. The following table gives the average results from a number of trials carried out with trembling and smoothly running machines :—

—	Balanced.		Unbalanced.	
	Skim milk. Per cent. fat.		Skim Milk. Per cent. fat.	
Average (6 experiments) ...	·03		·17	

It will be noticed that in unbalanced or unsecured separators the loss of butter fat may be increased as high as six times above the normal.

5. *Cleanliness of Machine.*—However carefully milking may be carried out by the operator, the milk will be found to contain a certain percentage of impurities such as dirt, dust, etc., which has gained access during its production. This foreign matter, together with a portion of the albumen present in milk, collects in the separator bowl, forming the so-called separator slime. This is deposited largely on the walls of the bowl and between the internal contrivances. It has been found that the fat lost in the skim milk by the use of unclean separators was approximately three times as great as when using a clean separator bowl. This provides an additional reason—besides the all-important one of producing clean cream—for the washing of separators after each separation.

## REPORT OF SHEEP-FEEDING EXPERIMENT CARRIED OUT AT MURESK AGRICULTURAL COLLEGE.

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[Being a thesis accepted as partial fulfilment of the requirements of the Degree Bachelor of Science in Agriculture with Honours in the University of Western Australia.]

*Introduction.*—Since the beginning of the twentieth century many investigations have been carried out all over the world in connection with Animal Nutrition.

These include investigations into the nutritive value of foods, disorders arising from faulty nutrition and many other problems.

In Western Australia there is probably no problem in connection with stock of more importance than that concerned with handfeeding during the dry period of the year.

In the South-Western part of Western Australia the climate is of the Mediterranean type and there is practically no summer rain. The months of November to March are typically dry, and pastures are frequently dormant, or scanty, from about the end of November until the following May.

It is therefore necessary, wherever the land is fully stocked, to supplement the dry herbage with some additional fodder through the latter part of summer and the beginning of winter until the new feed has made some growth.

Little experimental work has been done to discover the most suitable kind of feed to provide this supplement. The problem seems important, as without some handfeeding it is doubtful whether most farms can be kept fully stocked all the year round. The experiment reported in this paper was designed to obtain some reliable information on the subject.

*Method.*—As in the greater part of the agricultural districts sheep are the class of stock usually grazed, these animals were chosen for the experiment. The flock available consisted of two-tooth Merino ewes which were dropped in May, 1928; they were a very even lot as regards type. From these, one hundred of the best were selected for the experiment. The sheep selected were then divided into five lots of twenty sheep each, the lots being made as even in aggregate live weight and in type as it was possible to judge.

Unfortunately, although rams had never been put with the selected ewes, it became evident later that a few had been accidentally mated, as these gave birth to lambs during the course of the experiment.

The number of ewes which lambed is stated in Table I. Their live-weights were excluded from the final results, thus reducing somewhat the numbers of

sheep in the various lots, but their presence involved no other disabilities. In view of their small number it is considered that the omission of these sheep does not seriously affect the results.

TABLE I.

*Number of Ewes lambing and effective number in each lot.*

Lot No.	Ewes Lambing.	Effective No.
1	2	18
2	1	19
3	3	17
4	3	17
5	4	16

For the purpose of the experiment each of the sheep carried a numbered ear tag. They were weighed individually, the weight of each sheep being recorded against its respective number. Weighing was conducted to the nearest half-pound in a crate specially built for this purpose. The operation was carried out at the same time of day on each occasion. As far as possible it was conducted at intervals of one week; on several occasions, however, the length of the intervals was altered owing to the fact that there had been rain, and in consequence the sheep were wet.

The site selected for the experiment was five acres of gently rising ground close to the college; this land was subdivided into five small paddocks of one acre each. One of these paddocks was used for each lot of sheep. The paddocks were entirely clear of vegetation except for a few trees along the fence bounding them on the North-West side; these consisted of Jams (*Acacia acuminata*), and were large enough to provide sufficient shade for every paddock.

The experiment was commenced on 24th March and was continued for a period of just over fourteen weeks until 2nd July, when feed was once more becoming abundant.

*Rations.*—As the original idea of the experiment was to determine the best supplements for natural pasture the ideal base of the ration would have been pasture. This, however, was impossible of achievement. As wheaten stubble, however, forms a considerable proportion of the ordinary summer pasture of the agricultural districts, an endeavour was made to simulate stubble conditions by providing wheaten straw, in practically unlimited quantities, as a basal ration.

In selecting the supplementary fodders, it seemed better to avoid purchased materials at this stage and use only such as can be produced on the farm. The different feeds tested were wheaten chaff, silage, oats, and mixtures of chaff with oats and of silage with oats.

The rations fed, in lbs. per head per day, are given in Table II.

TABLE II.

*Experimental Rations Fed.*

Lot No.	Chaff.	Silage.	Oats.
	lbs. per head.	lbs. per head.	lbs. per head.
1	1	...	...
2	...	3	...
3	...	...	$\frac{1}{2}$
4	$\frac{1}{2}$	...	$\frac{1}{4}$
5	...	$1\frac{1}{2}$	$\frac{1}{4}$

The basal ration, straw, was scattered on the ground in liberal quantities twice weekly; the supplementary rations (Table II.) were fed daily at 8 a.m. in shallow troughs in the centre of the pens, the troughs being sufficiently large to accommodate with ease all the sheep in each pen at one and the same time. No difficulty was experienced in getting the sheep accustomed to feeding out of the troughs.

The chaff, silage, and oats used were all produced on the College farm.

The chaff was made from wheaten hay cut in 1929 and was of fair quality. It was at times, however, somewhat dusty and was rather badly infested with grain moth.

The silage was made from an oaten crop in 1929 and was a good sample of acid brown silage, light yellow-brown in colour.

The oats were Algerian feed oats of fair average quality.

In Table III. are given the analyses of the three feeds as determined from representative samples by the Government Analyst.

TABLE III.  
*Analyses of Feeds.*

	Chaff.	Oats.	Silage.
Moisture ... ..	12.00	6.00	64.00
Ash ... ..	4.84	3.91	2.18
Crude protein ... ..	2.91	9.58	1.67
Ether extract ... ..	2.36	8.18	.91
Fibre ... ..	27.68	11.03	10.78
N free extractives ...	50.21	61.30	20.46
	100.00	100.00	100.00

On two occasions in the course of the experiment the quantities of the feed supplied were altered, viz., on 7th April the ration for Lot 1 was reduced to  $\frac{3}{4}$  lb. chaff per head and that for Lot 2 to 2 lbs. silage per head, as this was approximately all that these lots would consume; again on 12th May, on account of cooler weather, it was thought necessary to increase the amount of feed of all lots. As, however, Lot 1 were still not consuming all their ration, their ration was left unchanged. The increases in the rations of the other lots were as follows:—

Lot 2 increased to  $2\frac{1}{2}$  lbs. silage.

Lot 3 increased to  $\frac{3}{4}$  lb. oats.

Lot 4 and Lot 5 increased by  $\frac{1}{8}$  lb. oats each.

Records of all rejected feed were kept throughout, but appreciable amounts were left by Lots 1 and 2 only.

*Results.*—The average weights of the sheep in each of the five lots at the beginning of the experiment were reasonably close to one another, there being less than 2 lbs. difference between the heaviest and the lightest. These average

weights, together with the average weights at each successive weighing, are given in Table IV.

TABLE IV.  
AVERAGE WEIGHT OF SHEEP IN EACH LOT AT SUCCESSIVE WEIGHINGS.

Lot No.	24-3-30	31-3-30	7-4-30	14-4-30	23-4-30	28-4-30	6-5-30
1 ... ..	72.61	73.75	73.61	72.31	67.47	67.97	67.64
2 ... ..	73.05	76.53	73.92	72.71	69.66	70.76	70.50
3 ... ..	71.53	72.18	72.09	72.50	69.00	70.82	69.71
4 ... ..	73.47	74.07	74.24	74.09	71.29	72.29	71.50
5 ... ..	71.72	73.34	72.75	73.06	70.53	70.38	70.28

Lot No.	12-5-30	19-5-30	26-5-30	2-6-30	9-6-30	16-6-30	2-7-30
1 ... ..	66.17	65.08	66.19	65.86	65.25	62.00	60.22
2 ... ..	69.84	68.71	68.21	66.76	65.18	61.79	61.03
3 ... ..	70.97	70.76	71.59	71.38	69.32	68.44	68.12
4 ... ..	71.91	70.29	70.68	69.85	69.35	69.15	66.79
5 ... ..	70.25	69.81	71.37	70.56	70.13	69.69	68.47

In Table V. are shown the variations from the initial average in the average weight of each lot at successive weighings, while in Table VI. these variations are shown as percentages of the average weight at the beginning of the experiment.

TABLE V.  
VARIATIONS FROM INITIAL AVERAGE WEIGHTS.

Lot No.	31-3-30	7-4-30	14-4-30	23-4-30	28-4-30	6-5-30
1 ... ..	+1.14	+1.00	-0.31	-5.14	-4.64	-4.97
2 ... ..	+3.47	+0.86	-0.35	-3.40	-2.29	-2.55
3 ... ..	+0.65	+0.56	+0.97	-2.44	-0.70	-1.82
4 ... ..	+1.50	+0.77	+0.62	-2.17	-1.17	-1.96
5 ... ..	+1.63	+1.04	+1.35	-1.18	-1.34	-1.43

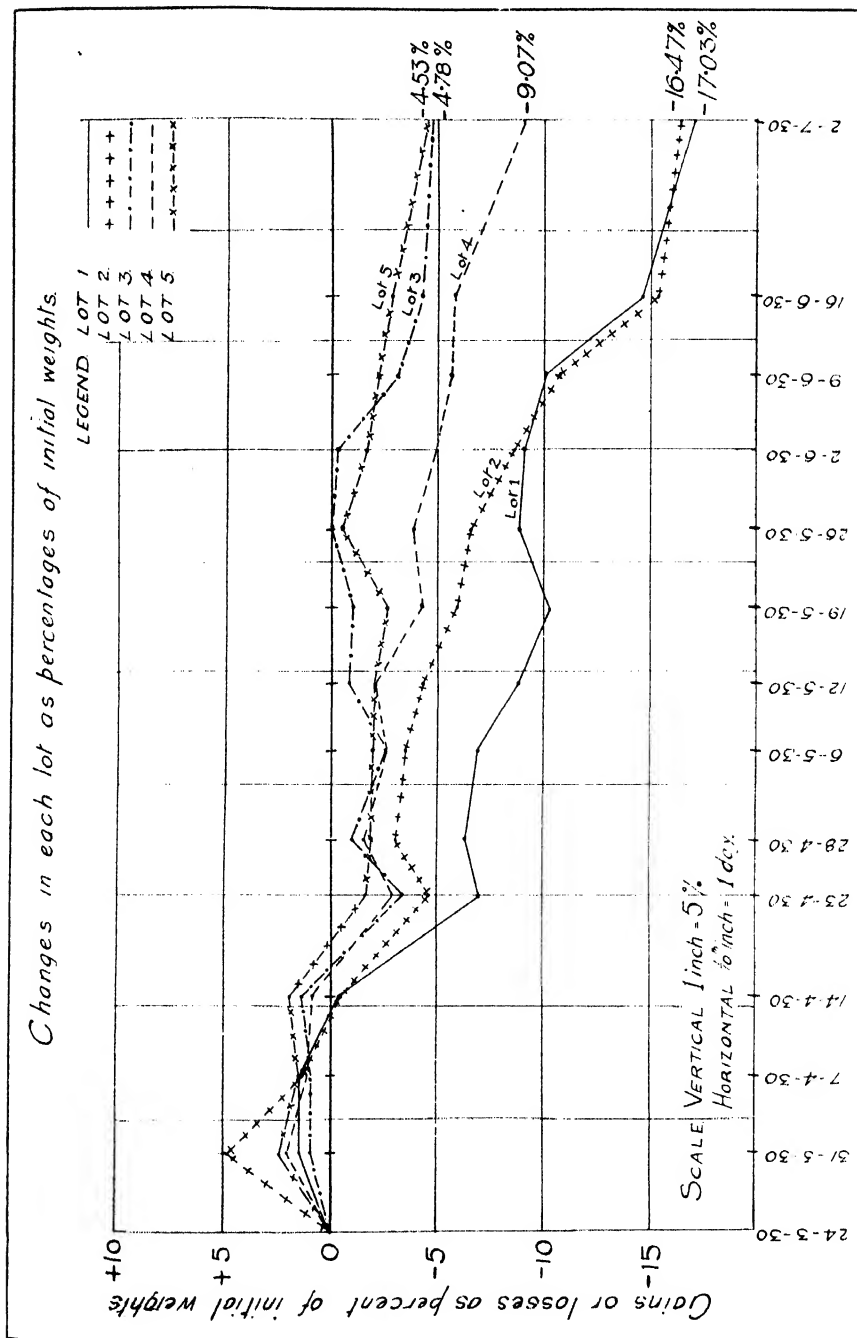
Lot No.	12-5-30	19-5-30	26-5-30	2-6-30	9-6-30	16-6-30	2-7-30
1 ... ..	-6.44	-7.52	-6.41	-6.74	-7.35	-10.60	-12.38
2 ... ..	-3.21	-4.34	-4.84	-6.29	-7.87	-11.26	-12.02
3 ... ..	-0.56	-0.77	+0.05	-0.16	-2.22	-3.10	-3.42
4 ... ..	-1.55	-3.17	-2.79	-3.61	-4.11	-4.32	-6.67
5 ... ..	-1.46	-1.90	-0.34	-1.15	-1.59	-2.03	-3.25

TABLE VI.  
PERCENTAGE VARIATIONS FROM INITIAL AVERAGE WEIGHTS.

Lot No.	31-3-30	7-4-30	14-4-30	23-4-30	28-4-30	6-5-30
1 ... ..	+1.57	+1.38	-0.43	-7.07	-6.38	-6.84
2 ... ..	+4.75	+1.18	-0.48	-4.66	-3.14	-3.49
3 ... ..	+0.91	+0.78	+1.36	-3.41	-0.98	-2.54
4 ... ..	+2.04	+1.03	+0.84	-2.95	-1.59	-2.67
5 ... ..	+2.27	+1.45	+1.88	-1.64	-1.87	-1.99

Lot No.	12-5-30	19-5-30	26-5-30	2-6-30	9-6-30	16-6-30	2-7-30
1 ... ..	-8.86	-10.34	-8.83	-9.28	-10.12	-14.60	-17.03
2 ... ..	-4.39	-5.94	-6.62	-8.61	-10.78	-15.40	-16.47
3 ... ..	-0.78	-1.08	+0.07	-0.22	-3.11	-4.34	-4.78
4 ... ..	-2.11	-4.31	-3.79	-4.91	-5.59	-5.87	-9.07
5 ... ..	-2.04	-2.65	-0.47	-1.60	-2.22	-2.83	-4.53



In Figure I. the data of Table VI. are given in graphical form.

An inspection of these figures and the graph at once draws attention to a number of points, viz.:—

1. There was a decided increase in all lots during the first week, followed by a fall in the second week. The increase may, possibly, be due to the restriction of exercise, the gain not being maintained as the sheep became accustomed to the conditions.

2. All lots show a pronounced loss between 14th and 23rd April. This coincides with a period in which .45 inches of rain and some very low maximum and minimum temperatures were recorded, and can almost certainly be ascribed to these conditions.

3. There is no very marked effect to be ascribed to the increase in the rations on 12th May, but possibly the increase in weight between 19th and 26th May in Lots 3, 4, and 5 can be credited to this cause.

4. The lines appear to fall into three distinct groups:—

(a) the coarse fodders, chaff and silage, which appear to be definitely inferior as supplements;

(b) the mixture of chaff and oats which, although considerably superior to chaff or silage alone, is still inferior to the other two supplements tried;

(c) oats alone and oats with silage, which appear to be about equal in value and considerably better than the other three.

A study of the analyses of the various foods suggests a probable explanation of this grouping.

The analyses, although not identical, agree fairly closely with those given by Kellner (1) and Wood (2) for the same class of foods, it seems reasonable therefore, to assume that the percentage digestibility of the nutrients in the various foods will be of the same order also. Working on this assumption, the starch equivalent and nutritive ratio of each of the supplementary rations per head per day was calculated. These figures are given in Table VII.

TABLE VII.\*

*Starch equivalents and nutritive ratios.*

—	Chaff.	Silage.		Oats.		Chaff and Oats.		Silage and Oats.	
		1st ration.	2nd ration.	1st ration.	2nd ration.	1st ration.	2nd ration.	1st ration.	2nd ration.
S.E. ...	lbs. .41	lbs. .30	lbs. .37	lbs. .35	lbs. .53	lbs. .45	lbs. .54	lbs. .40	lbs. .49
N.R. ...	23.0	19.9	19.9	8.8	8.8	14.4	13.0	13.7	12.4

It is obvious at once that while the difference in energy value of the five rations is fairly considerable, there is no clear connection with the changes in live weight. When the nutritive ratios are studied, however, even greater variation is noted, but it is at once apparent that the two foods which were found

\* First ration 7th April to 12th May. Second ration 12th May to end.

least satisfactory are those with nutritive ratios admittedly too wide for general feeding and especially for sheep, whose wool is highly nitrogenous. The two mixed rations are also somewhat wide but conform more to recognised standards, while oats show a ratio of medium width.

The straw which formed the basal ration would probably provide the necessary extra starch equivalent but would certainly be still lower than chaff in protein content, and hence unable to correct the width of the ratios. It appears probable that deficiency of protein was a main cause of the poorer results from the first two rations.

Oats alone (ration 3) was the most favourable in nutritive ratio, but it did not, however, excel ration 5 probably because along with wheaten straw it was too little laxative.

There is no explanation from the figures (Table VII.) of the different results from rations 4 and 5, and the superiority of ration 5 is almost certainly due to its more laxative character. The results indicate that on dry pasture, silage included in a mixed feed of suitable nutritive ratio has an important dietetic effect.

In farm practice any one of the three rations: oats, oats + chaff, or oats + silage, would be found satisfactory, but in varying measures. The decision as to which one should be adopted in any particular case would depend on individual circumstances. Where the grazing includes a green bite, *e.g.*, weeds in stubble, oats alone would probably be found entirely satisfactory; where there is nothing but dry stubble the inclusion of silage with oats is economical and useful. Good chaff, especially when harvested early, has undoubted uses either alone or in mixtures. A controlling factor in any instance will be the ruling prices for oats and chaff and the facilities for ensiling green fodder.

*Costs.*—Another important angle from which the various rations must be viewed is that of actual cost of production.

It was impossible to work out actual costs for the materials used, and no figures for production in Western Australia were available. Reliable figures for hay and oats are available for South Australia (3), however, and these should be fairly close to costs in this State. For silage no exact figures could be obtained, so an attempt was made to calculate the approximate cost under average conditions.

The average costs obtained as above were:—

					£	s.	d.
Cereal hay, per ton	..	..	..	..	2	16	5
Silage, per ton	..	..	..	..	0	17	0
Oats, per bushel	..	..	..	..	0	2	7

As the hay was fed as chaff it is necessary to add the cost of chaffing: this is, on an average, 12s. 6d. per ton, making the total cost of the chaff £3 8s. 11d.



From these figures the cost per day of the total ration for each lot of 20 sheep was calculated, and the results so obtained are given in Table VIII.

TABLE VIII.

*Cost of Rations per day.*

Lot No.	Period.*	Chaff.	Silage.	Oats.	Total.
		d.	d.	d.	d.
1 ... ..	Whole	5.54	...	...	5.54
2 ... ..	1st	...	3.64	...	3.64
	2nd	...	4.55	...	4.55
3 ... ..	1st	...	...	7.75	7.75
	2nd	...	...	11.62	11.62
4 ... ..	1st	3.69	...	3.88	7.57
	2nd	3.69	...	5.81	9.50
5 ... ..	1st	...	2.72	3.88	6.60
	2nd	...	2.72	5.81	8.53

The total cost of the various rations for the whole period of the experiment is given in Table IX.

TABLE IX.

*Total Cost of Rations.*

Lot No.	Total Cost.
	£ s. d.
1 ... ..	2 6 2
2 ... ..	1 14 3
3 ... ..	4 1 0
4 ... ..	3 11 3
5 ... ..	3 3 3

At the prices employed it is obvious that the two coarse fodders are decidedly the least costly. Next in order comes oats + silage, then oats + chaff, while oats alone was the most expensive supplement. Taking live-weights into account, therefore, it is apparent that where silage is available a mixture of silage and oats is the most suitable supplement to use for maintenance of sheep on dry stubble.

*Estimate of Experimental Error.*—In making practical deductions from average results, whether in crop manuring or in feeding tests with livestock, it is necessary to analyse carefully the experimental data in order to avoid false conclusions. Thus in an experiment involving the live-weight of animals it is expected that there will be wide variation in the changes of weights between different animals in the same lot owing to subtle differences in the individual.

\* First period up to 12th May. Second period 12th May to end.

In order to minimise the effect of these variations it is most desirable that large numbers of individuals should be included in each lot.\*

In Table I. of Appendix are given the initial live-weight of each sheep and the changes in weight, both absolute and as percentages of the original weight. From the percentage variations are calculated the standard deviation for each lot.

In Table X. are given the number of sheep in each lot, the range of the variations in weight, the mean percentage variations with their probable errors and the standard deviations for each lot.

TABLE X.

Lot No.			No. of sheep.	Range of variation.	Mean per cent. variation.		Standard deviation.
							$\sigma$
1	...	...	18	-2.7 to -23.3	-17.2	$\pm 1.64$	4.39
2	...	...	19	-9.6 to -24.4	-16.5	$\pm 1.42$	4.00
3	...	...	17	+10.6 to -14.6	-4.7	$\pm 2.23$	5.63
4	...	...	17	+1.3 to -26.2	-9.1	$\pm 2.39$	6.02
5	...	...	16	+9.4 to -13.5	-4.6	$\pm 2.82$	6.69

It will be seen that the range of variations is large, as was expected, being 14.8 in the smallest case (Lot 2) and as much as 27.5 in the largest (Lot 4). This bears out the need for large numbers in order to secure a reliable average.

To test the significance of the differences between the means of the various lots, use is made of the equation for the standard error of the difference between two means (4), viz.:-

$$\epsilon_{12} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

The difference between each pair of means with its standard error calculated from this equation are given in Table XI.

TABLE XI.

*Differences between means and S.E. of differences.*

Pairs of Lots.		Differences.	S.E.	Pairs of Lots.		Differences.	S.E.
1 and 2	...	0.7	1.38	2 and 4	7.4	1.73	
1 and 3	...	12.5	1.71	2 and 5	11.9	1.91	
1 and 4	...	8.1	1.79	3 and 4	4.4	2.00	
1 and 5	...	12.6	1.97	3 and 5	0.1	2.16	
2 and 3	...	11.8	1.64	4 and 5	4.5	2.22	

A study of this table reveals that the differences which may be regarded as significant are those between Lot 1 and each of the last three lots and between Lot 2 and each of the same lots. The differences in the variation in weight between Lots 3 and 4 and between Lots 4 and 5 cannot be regarded as certainly

\* Wood and Stratton calculated that where a difference of effect as small as 10 per cent. was expected, not less than 29 animals should be used in each lot. *Journ. Ag. Sc.* III., 432.

significant, but are probably so as the difference in each case is more than twice the standard error. The differences between Lots 1 and 2 and between Lots 3 and 5 must be regarded as of no significance.

*Wool.*—At the end of the experiment the sheep in all lots were examined closely by the lecturer in wool-classing at the College to determine whether any changes had taken place in the wool.

He found that in Lots 1 and 2 there had been a definite fining off of the fibre since the inception of the experiment, presumably due to malnutrition. In the other three lots a slight change was noticeable in the wool of some of the sheep, but there was less change in Lot 5 than in either Lot 3 or Lot 4.

*Health.*—The general health of the experimental animals, except for a slight skin affection of the mouth in Lot 1 which lasted about a fortnight, was good throughout; the sheep in Lots 1 and 2, however, became rather weak.

It is of interest to note that of the ewes which lambled, those in Lots 1 and 2 were unable to rear their lambs owing to lack of milk, while all those in the other lots could provide an adequate supply.

*Relation of Live-weight to Temperature.*—As previously noted (see page 7) it appeared, on one occasion, that temperature had a direct effect on the live weight of the sheep since all lots were similarly affected. This led the writer to investigate further whether there might be any connection between temperature and live-weight variations. The average live-weight of all the sheep in the experiment, at successive weighings, and the daily temperatures were plotted on the same sheet and the graphs of the live-weights and of maximum and mean temperatures appeared to have many points in common. The coefficient of correlation between live-weight and each of the series of temperatures was then calculated, and these are given in Table XII.

TABLE XII.

*Correlation of live-weight with temperature.*

Live-weight correlated with.			Coefficient of correlation.	
Max. temperatures	...	...	+·873	±·044
Min. temperatures	...	...	+·595	±·121
Mean temperatures	...	...	+·782	±·073

The Pearsonian coefficient of correlation may vary from +1 to —1. A coefficient of +1 indicates absolute direct correlation, a coefficient of —1 indicates absolute inverse correlation, while a coefficient of 0 shows entire absence of correlation; further, a coefficient to be significant should be more than six times its probable error.

It will be noted that in the case of the minimum temperatures the coefficient, although fairly high, is less than five times its probable error and cannot, therefore, be regarded as significant; in the case of the other two temperature series, however, the coefficient shows a very high degree of correlation and as the probable errors are small they are certainly significant.

## SUMMARY AND CONCLUSIONS.

1. Experiments were carried out in the supplementary feeding of sheep with five lots of from 16 to 19 sheep each. The experiments commenced on 24th March, 1930, and covered a period of just over fourteen weeks, ending on 2nd July. No sheep died during the experiments.

2. The five supplementary rations tried were chaff, silage, oats, chaff + oats and silage + oats. The amounts fed were intended to be approximately equal in energy value and were fed as a supplement to a basal ration of wheaten straw.

3. Of these five rations oats alone and silage + oats gave the best results, then came chaff + oats. Chaff alone and silage gave the poorest results. These latter appear to be definitely unsuitable by themselves as a supplement, but are satisfactory mixed with oats; this applies specially to silage. Oats by itself appears to be a satisfactory supplement. It would appear, therefore, that a store of oats is a valuable asset to a sheep farmer.

4. It seems likely that the factor limiting the value of certain of the feeds tried is protein, as the feeds which failed were definitely deficient in this nutrient. On dry pastures, however, if protein is sufficient, silage becomes of value on account of its laxative properties.

5. From the small numbers available it is unsafe to generalise, but it appears likely that chaff alone and silage alone are unsuitable as a supplementary ration for lambing ewes.

6. On the basis of the values quoted for the various fodders, silage is definitely the least costly with chaff next; as, however, these by themselves fall short of protein requirement for a maintenance ration on stubble pasture, the cost factor here is little relevant. Of the other three rations, silage + oats was the least costly, chaff + oats next, while oats alone ranked highest. Variation of quantities in the mixtures would of course alter the costs somewhat, but it appears safe to say that, with values approximating those quoted, a mixture of oats with silage would be the most satisfactory supplement to use.

7. It is obvious from the condition of many of the sheep in the agricultural districts at the beginning of winter that more attention should be paid by farmers to the hand-feeding of their stock. It is clear from the results of this experiment that it is not enough merely to supply even large quantities of such fodders as chaff and silage, but that where these are fed some food relatively rich in protein should be provided along with them. Oats appear to be such a food, and although oats are satisfactory when fed alone, it is more economical on dry pasture to feed them along with silage.

*Acknowledgments.*—My thanks are due to Professor Paterson, of the University of Western Australia, and to Mr. H. J. Hughes, Principal of the Muresk Agricultural College, for their many helpful suggestions with regard to this experiment and for assistance in the preparation of this paper.

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APPENDIX.  
TABLE I.

Lot 1.			Lot 2.			Lot 3.			Lot 4.			Lot 5.		
Sheep No.	Variation.		Sheep No.	Variation.		Sheep No.	Variation.		Sheep No.	Variation.		Sheep No.	Variation.	
	Initial live-weight.	Percentage of Initial weight.		Initial live-weight.	Percentage of Initial weight.		Initial live-weight.	Percentage of Initial weight.		Initial live-weight.	Percentage of Initial weight.		Initial live-weight.	Percentage of Initial weight.
	lbs.	°.		lbs.	°.		lbs.	°.		lbs.	°.		lbs.	°.
701	76.0	-14.0	708	78.0	-14.0	712	86.0	-1.5	718	83.0	-4.0	722	78.0	-4.0
702	81.5	-16.5	707	72.5	-17.0	713	70.0	-5.0	719	77.5	-4.0	723	71.5	-6.0
703	97.0	-13.5	708	82.0	-13.5	714	80.5	-6.0	720	84.5	-7.5	725	81.5	-8.4
704	83.1	-14.0	709	74.0	-10.5	715	71.5	-9.0	721	88.0	-23.0	726	78.5	-10.5
705	82.0	-18.0	710	86.5	-15.0	731	79.5	-0.5	739	75.5	+1.0	736	66.0	+5.0
711	68.5	-13.0	728	88.0	-15.0	744	74.5	-4.5	750	70.5	-6.0	738	78.5	-6.0
717	67.5	-11.5	729	81.5	-12.5	755	75.5	-5.5	745	69.5	-6.0	748	82.0	-7.6
727	75.0	-10.0	742	67.5	-16.5	760	72.5	-3.0	754	88.0	-6.0	753	69.5	+9.4
732	71.0	-17.0	746	69.5	-14.1	765	74.5	-4.0	759	79.5	-6.0	758	68.0	-7.4
737	73.0	-2.7	751	73.0	-15.0	769	68.0	+7.0	766	76.0	-4.0	764	70.5	-1.5
738	73.0	-23.3	756	67.0	-9.0	775	63.5	-5.5	776	66.5	-11.5	777	65.0	-3.0
739	68.5	-17.0	761	73.0	-7.0	781	73.0	-5.5	779	76.0	-1.0	780	71.5	-4.6
742	64.5	-20.4	764	71.5	-15.0	785	69.5	-2.0	783	70.0	-5.5	786	77.0	-3.9
743	68.5	-13.5	771	67.5	-8.5	789	64.5	-5.5	787	74.0	-6.5	788	65.5	-4.0
749	63.0	-16.4	780	63.5	-6.0	793	62.5	-0.0	794	61.5	-9.5	795	63.0	-8.5
751	62.0	-21.0	783	72.5	-13.1	798	61.5	-3.0	797	64.0	-6.5	796	61.5	-1.6
801	11.0	-10.5	795	58.5	-7.5									
801	63.5	-9.0	798	58.5	-11.0									
Total		-309.3	Total		-18.8	Total		-80.2	Total		-154.5	Total		-74.3
Mean		-17.2	Mean		-16.5	Mean		-4.7	Mean		-9.1	Mean		-4.6

## AGRICULTURAL SEEDS AND THEIR WEED-SEED IMPURITIES.

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(Continued from page 577, Vol. 7.)

Scientific Name.	Common Name.
<b>7. PAPILIONACEAE.</b>	
<b>i. <i>Medicago sativa</i></b> ... ..	Lucerne
Containing:—	
A. <i>Legumes</i> —	
<i>Medicago denticulata</i> ... ..	Burr Medic (2)
M. <i>lupulina</i> ... ..	Black Medic (3)
<i>Melilotus</i> spp. ... ..	Melilot (5)
<i>Trifolium dubium</i> ... ..	Suckling Clover
T. <i>incarnatum</i> ... ..	Crimson Clover
T. <i>pratense</i> ... ..	Red Clover (5)
T. <i>repens</i> ... ..	White Clover
B. <i>Grasses</i> —	
<i>Agrostis</i> sp. ... ..	Bent Grass
<i>Dactylis glomerata</i> ... ..	Cocksfoot
<i>Lolium perenne</i> ... ..	Perennial Rye-grass (2)
<i>Setaria italica</i> ... ..	Italian millet (6)
C. <i>Other Weeds</i> —	
<i>Amaranthus retroflexus</i> ... ..	Pigweed (5)
<i>Artemisia</i> sp. ... ..	Wormwood
<i>Brassica arvensis</i> ... ..	Wild Mustard
B. <i>nigra</i> ... ..	Black Mustard (2)
* <i>Carduus lanceolatus</i> ... ..	Spear Thistle (7)
<i>Carum</i> sp. ... ..	Caraway
<i>Chenopodium album</i> ... ..	Mexican Spinach (2)
<i>Cichorium intybus</i> ... ..	Chicory
* <i>Echium</i> sp. ... ..	Viper's Bugloss (2)
<i>Geranium molle</i> ... ..	Crowfoot
* <i>Iva axillaris</i> ... ..	Poverty weed
<i>Plantago lanceolata</i> ... ..	Ribgrass (8)
<i>Polygonum aviculare</i> ... ..	Wireweed (2)
* <i>P. convolvulus</i> ... ..	Bindweed (2)
<i>Prunella vulgaris</i> ... ..	Sellheal (3)
<i>Rumex acetosella</i> ... ..	Sorrel (6)
<b>ii. <i>Medicago denticulata</i></b> ... ..	Burr Trefoil
Containing:—	
A. <i>Legumes</i> —	
<i>Medicago sativa</i> ... ..	Lucerne
<i>Trifolium incarnatum</i> ... ..	Crimson Clover
T. <i>subterraneum</i> ... ..	Sub. Clover (2)
B. <i>Grasses</i> —	
<i>Bromus maximus</i> ... ..	Spear Grass
<i>Bromus hordeaceus</i> ... ..	Soft Brome
<i>Dactylis glomerata</i> ... ..	Cocksfoot
<i>Holcus lanatus</i> ... ..	Yorkshire Fog
<i>Hordeum murinum</i> ... ..	Barley Grass (3)

Scientific Name.					Common Name.
<b>C. Other Weeds—</b>					
<i>Erodium</i> sp. ...	...	...	...	...	Crowfoot (2)
<i>Plantago lanceolata</i> ...	...	...	...	...	Ribgrass
<i>Rumex acetosella</i> ...	...	...	...	...	Sorrel (4)
<i>Rumex</i> spp. ...	...	...	...	...	Docks (2)
<i>Sonchus oleracea</i> ...	...	...	...	...	Milk Thistle (2)
<b>III. <i>Mellilotus alba</i> ... .. . Bokhara Clover</b>					
Containing :—					
<b>A. Legumes—</b>					
<i>Medicago lupulina</i> ...	...	...	...	...	English Trefoil (2)
<i>M. sativa</i> ...	...	...	...	...	Lucerne
<i>Melilotus indica</i> ...	...	...	...	...	King Island Melilot
<b>B. Grasses—</b>					
<i>Setaria viridis</i> ...	...	...	...	...	Pigeon Grass
<b>C. Others—</b>					
<i>Amaranthus retroflexus</i> ...	...	...	...	...	Pigweed
<i>Geranium molle</i> ...	...	...	...	...	Crowfoot
<i>Plantago major</i> ...	...	...	...	...	Large Plantain (2)
<i>Rumex acetosella</i> ...	...	...	...	...	Sorrel
<i>Silene gallica</i> ...	...	...	...	...	French Catchfly
<i>Stellaria media</i> ...	...	...	...	...	Chickweed
<b>IV. <i>Trifolium dubium</i> ... .. . Suckling Clover</b>					
Containing :—					
<b>A. Legumes—</b>					
<i>Trifolium glomeratum</i> ...	...	...	...	...	Cluster Clover (2)
<i>T. hybridum</i> ...	...	...	...	...	Alsike Clover
<i>T. pratense</i> ...	...	...	...	...	Red Clover
<i>T. repens</i> ...	...	...	...	...	White Clover
<b>B. Grasses—</b>					
<i>Holcus lanatus</i> ...	...	...	...	...	Yorkshire Fog (6)
<i>Phleum pratense</i> ...	...	...	...	...	Timothy
<b>C. Other Weeds—</b>					
<i>Amaranthus retroflexus</i> ...	...	...	...	...	Pigweed (3)
<i>Anagallis arvensis</i> ...	...	...	...	...	Pimpernel
<i>Cerastium vulgatum</i> ...	...	...	...	...	Chickweed (2)
<i>Geranium molle</i> ...	...	...	...	...	Crowfoot
<i>Juncus</i> sp. ...	...	...	...	...	Toadrush
<i>Plantago lanceolata</i> ...	...	...	...	...	Ribgrass (3)
<i>Rumex acetosella</i> ...	...	...	...	...	Sorrel (6)
<i>Sherardia arvensis</i> ...	...	...	...	...	Field Madder (2)
<i>Silene gallica</i> ...	...	...	...	...	French Catchfly (2)
<i>Spargula arvensis</i> ...	...	...	...	...	Spurry
<i>Stellaria media</i> ...	...	...	...	...	Chickweed (2)
<b>V. <i>Trifolium hybridum</i> ... .. . Alsike Clover</b>					
Containing :—					
<b>A. Legumes—</b>					
<i>Medicago lupulina</i> ...	...	...	...	...	English Trefoil
<i>Trifolium dubium</i> ...	...	...	...	...	Suckling Clover (2)
<i>T. glomeratum</i> ...	...	...	...	...	Cluster Clover (3)
<i>T. pratense</i> ...	...	...	...	...	Red Clover (2)
<i>T. repens</i> ...	...	...	...	...	White Clover (4)
<i>T. subterraneum</i> ...	...	...	...	...	Subterranean Clover

## Scientific Name.

## Common Name.

B. *Grasses*—

<i>Holcus lanatus</i>	...	...	...	...	Yorkshire Fog (4)
<i>Phleum pratense</i>	...	...	...	...	Timothy (6)
<i>Poa</i> sp.	...	...	...	...	Winter Grass

C. *Other Weeds*—

<i>Amaranthus retroflexus</i>	...	...	...	...	Pigweed
<i>Arenaria</i> sp.	...	...	...	...	Sand Spurry
<i>Capsella bursa-pastoris</i>	...	...	...	...	Shepherd's Purse
<i>Geranium molle</i>	...	...	...	...	Crowfoot (2)
<i>Lepidium ruderalis</i>	...	...	...	...	Wild Cress
<i>Lychnis alba</i>	...	...	...	...	White Campion
<i>Plantago lanceolata</i>	...	...	...	...	Ribgrass (3)
<i>P. major</i>	...	...	...	...	Large Plantain
* <i>Roseda luteola</i>	...	...	...	...	Wild Mignonette
<i>Rumex acetosella</i>	...	...	...	...	Sorrel (5)
<i>Rumex</i> spp.	...	...	...	...	Docks (3)
<i>Sherardia arvensis</i>	...	...	...	...	Field Madder
<i>Silene noctiflora</i>	...	...	...	...	Catchfly (2)
<i>Stellaria media</i>	...	...	...	...	Chickweed (3)
<i>Thlaspi arvense</i>	...	...	...	...	Stinkweed

vi. *Trifolium repens* ... .. White Clover

## Containing :—

A. *Legumes*—

<i>Lotus hispidus</i>	...	...	...	...	Boyd's Clover (3)
<i>Medicago denticulata</i>	...	...	...	...	Burr Medic (3)
<i>Trifolium agrarium</i>	...	...	...	...	Hop Clover (3)
<i>T. arvense</i>	...	...	...	...	Hare's Foot Clover
<i>T. dubium</i>	...	...	...	...	Suckling Clover (9)
<i>T. incarnatum</i>	...	...	...	...	Crimson Clover
<i>T. hybridum</i>	...	...	...	...	Alsike Clover
<i>T. pratense</i>	...	...	...	...	Red Clover

B. *Grasses*—

<i>Holcus lanatus</i>	...	...	...	...	Yorkshire Fog (6)
<i>Lolium perenne</i>	...	...	...	...	Perennial Rye-grass (2)
<i>Phalaris minor</i>	...	...	...	...	Canary Grass

C. *Other Weeds*—

<i>Amaranthus retroflexus</i>	...	...	...	...	Pigweed (2)
<i>Anagallis arvensis</i>	...	...	...	...	Pimpernel
* <i>Carduus lanceolatus</i>	...	...	...	...	Spear Thistle
<i>Chenopodium album</i>	...	...	...	...	Mexican Spinach (3)
<i>Cichorium intybus</i>	...	...	...	...	Chicory (3)
* <i>Cuscuta</i> spp.	...	...	...	...	Dodder (4)
<i>Geranium molle</i>	...	...	...	...	Crowfoot (3)
<i>Juncus</i> sp.	...	...	...	...	Toadrush
<i>Lychnis alba</i>	...	...	...	...	White Campion
<i>Myosotis arvensis</i>	...	...	...	...	Forget me not (4)
<i>Plantago lanceolata</i>	...	...	...	...	Ribgrass (18)
<i>P. major</i>	...	...	...	...	Large Plantain (2)
<i>Prunella vulgaris</i>	...	...	...	...	Selfheal
<i>Ranunculus</i> sp.	...	...	...	...	Buttercup
* <i>Roseda luteola</i>	...	...	...	...	Wild Mignonette
<i>Rumex acetosella</i>	...	...	...	...	Sorrel (18)
<i>Rumex</i> spp.	...	...	...	...	Docks (2)
<i>Sherardia arvensis</i>	...	...	...	...	Field Madder (4)
<i>Silene gallica</i>	...	...	...	...	French Catchfly (6)
<i>S. noctiflora</i>	...	...	...	...	Catchfly (2)
<i>Spergula arvensis</i>	...	...	...	...	Spurry
<i>Stellaria media</i>	...	...	...	...	Chickweed (3)



Scientific Name.				Common Name.
<b>vii. <i>Trifolium cernuum</i></b> ... ..				<b>Drooping Flowered Clover</b>
Containing :—				
A. <i>Legumes</i> —				
<i>Trifolium agrarium</i> ... ..	...	...	...	Hop Clover (2)
<i>T. dubium</i> ... ..	...	...	...	Suckling Clover (2)
<i>T. glomeratum</i> ... ..	...	...	...	Cluster Clover (5)
<i>T. tomentosum</i> ... ..	...	...	...	Woolly Clover (2)
B. <i>Grasses</i> —				
<i>Aira caryophylla</i> .. ..	...	...	...	Fairy Grass (2)
<i>Bromus maximus</i> ... ..	...	...	...	Brome Grass
<i>B. hordeaceus</i> ... ..	...	...	...	Soft Brome
<i>Festuca bromoides</i> ... ..	...	...	...	Silver Grass (2)
<i>Holcus lanatus</i> ... ..	...	...	...	Yorkshire Fog
<i>Hordeum murinum</i> ... ..	...	...	...	Barley Grass (2)
<i>Lolium perenne</i> ... ..	...	...	...	Perennial Rye-grass (2)
<i>Phleum pratense</i> ... ..	...	...	...	Timothy
C. <i>Other Weeds</i> —				
<i>*Bartsia viscosa</i> .. ..	...	...	...	Yellow Weed (2)
<i>Hypochaeris glabra</i> .. ..	...	...	...	Catscar (2)
<i>H. radicata</i> ... ..	...	...	...	Flatweed (2)
<i>Juncus</i> spp. ... ..	...	...	...	Toadrush
<i>Rumex acetosella</i> .. ..	...	...	...	Sorrel (4)
<i>Silene noctiflora</i> .. ..	...	...	...	Catchfly (2)
<b>viii. <i>Trifolium glomeratum</i></b> . . . . .				
<b>Cluster Clover</b>				
Containing :—				
A. <i>Legumes</i> —				
<i>Melilotus indica</i> ... ..	...	...	...	King Island Melilot (2)
<i>Trifolium agrarium</i> ... ..	...	...	...	Hop Clover (2)
<i>T. arvense</i> ... ..	...	...	...	Hare's Foot Clover (2)
<i>T. dubium</i> ... ..	...	...	...	Yellow Suckling Clover (7)
<i>T. pratense</i> ... ..	...	...	...	Red Clover
<i>T. repens</i> ... ..	...	...	...	White Clover (2)
<i>T. tomentosum</i> ... ..	...	...	...	Woolly Clover
B. <i>Grasses</i> —				
<i>Holcus lanatus</i> ... ..	...	...	...	Yorkshire Fog (2)
C. <i>Other Weeds</i> —				
<i>Cerastium vulgatum</i> ... ..	...	...	...	Chickweed (2)
<i>Hypochaeris radicata</i> ... ..	...	...	...	Flatweed
<i>Plantago lanceolata</i> ... ..	...	...	...	Ribgrass (2)
<i>Rumex acetosella</i> ... ..	...	...	...	Sorrel (7)
<i>Silene inflata</i> ... ..	...	...	...	Campion
<i>Sisymbrium officinale</i> ... ..	...	...	...	Hedge Mustard (2)
<i>Tunica prolifera</i> ... ..	...	...	...	Wild Pink
<b>ix. <i>Trifolium Alexandrinum</i></b> ... ..				<b>Berseem Clover</b>
Containing :—				
A. <i>Legumes</i> —				
<i>Medicago lupulina</i> ... ..	...	...	...	English Trefoil
<i>Melilotus indica</i> ... ..	...	...	...	King Island Melilot (3)
B. <i>Grasses</i> —				
<i>Lolium perenne</i> ... ..	...	...	...	Perennial Rye-grass (2)

Scientific Name.				Common Name.
<b>C. Other Weeds—</b>				
Brassica alba	...	...	...	White Mustard
B. arvensis	...	...	...	Wild Mustard
B. nigra	...	...	...	Black Mustard (2)
Cichorium intybus	...	...	...	Chicory (7)
Rumex spp.	...	...	...	Docks (6)
Sonchus oleraceus	...	...	...	Milk Thistle
<b>x. Trifolium incarnatum</b>	...	...	...	Crimson Clover
Containing :—				
<b>A. Legumes—</b>				
Medicago lupulina	...	...	...	English Trefoil (6)
Melilotus alba	...	...	...	Bokhara Clover
Trifolium dubium	...	...	...	Suckling Clover
T. pratense	...	...	...	Red Clover
T. repens	...	...	...	White Clover
Vicia sativa	...	...	...	Common Vetch
<b>B. Grasses—</b>				
Alopecurus sp.	...	...	...	Foxtail
Bromus hordeaceus	...	...	...	Soft Brome
Lolium perenne	...	...	...	Perennial Rye-grass
<b>C. Other Weeds—</b>				
*Brassica sinapistrum	...	...	...	Charlock (3)
Brassica spp.	...	...	...	Mustards (9)
*Centaurea cyaneus	...	...	...	Star Thistle
Cerastium vulgatum	...	...	...	Mouse Eared Chickweed
Chenopodium album	...	...	...	Mexican Spinach
Chrysanthemum leucanthemum	...	...	...	Ox-eye Daisy
*Cnicus arvensis	...	...	...	Californian Thistle
Crepis virens	...	...	...	Smooth Crepis
Geranium dissectum	...	...	...	Wild Geranium (10)
G. molle	...	...	...	Cranebill (3)
*Guizotia abyssinica	...	...	...	
Lychnis alba	...	...	...	White Campion (4)
Plantago lanceolata	...	...	...	Ribgrass (2)
Poterium sanguisorba	...	...	...	Sheep's Burnet (2)
*Polygonum sp.	...	...	...	Smart Weed
Ranunculus repens	...	...	...	Creeping Buttercup (3)
Rumex acetosella	...	...	...	Sorrel (6)
Rumex spp.	...	...	...	Docks (3)
Scandix Pecten-Veneris	...	...	...	Shepherd's Needle
Sherardia arvensis	...	...	...	Field Maddler (5)
Silene noctiflora	...	...	...	Catchfly (2)
Stellaria media	...	...	...	Chickweed
<b>xi. Trifolium pratense perenne</b>	...	...	...	Cow Grass
Containing :—				
<b>A. Legumes—</b>				
Medicago lupulina	...	...	...	English Trefoil (5)
Trifolium incarnatum	...	...	...	Crimson Clover (2)
T. repens	...	...	...	White Clover (3)
<b>B. Grasses—</b>				
Danthonia sp.	...	...	...	Wallaby Grass
Lolium perenne	...	...	...	Perennial Rye-grass (2)
Phleum pratense	...	...	...	Timothy

Scientific Name.				Common Name.
C. <i>Other Weeds</i> —				
Apium graveolens	...	...	...	Celery
Brassica spp.	...	...	...	Mustard (2)
*Carduus lanceolatus	...	...	...	Spear Thistle (2)
Chrysanthemum leucanthemum	...	...	...	Ox-eye Daisy
Cichorium intybus	...	...	...	Chicory
*Cuscuta spp.	...	...	...	Dodder
Daucus carota	...	...	...	Carrot
Lychnis alba	...	...	...	White Campion
Malva sp.	...	...	...	Mallow
Mentha sp.	...	...	...	Mint
Plantago lanceolata	...	...	...	Ribgrass (2)
*Polygonum aviculare	...	...	...	Wireweed
Prunella vulgaris	...	...	...	Selfheal (2)
Rumex acetosella	...	...	...	Sorrel (3)
Rumex spp.	...	...	...	Docks (4)
Silene noctiflora	...	...	...	Catchfly (5)
Stellaria media	...	...	...	Chickweed (2)
xii. <i>Trifolium subterraneum</i> ... .. Subterranean Clover				
Containing :—				
A. <i>Legumes</i> —				
Medicago denticulata	...	...	...	Burr Medic (8)
M. lupulina	...	...	...	Black Medic (2)
Trifolium agrarium	...	...	...	Hop Clover (8)
T. cernuum	...	...	...	Drooping Flowered Clover (2)
T. dubium	...	...	...	Yellow Suckling Clover (2)
T. glomeratum	...	...	...	Cluster Clover (10)
T. tomentosum	...	...	...	Woolly Clover (4)
B. <i>Grasses</i> —				
Aira caryophylla	...	...	...	Silvery Grass (3)
Alopecurus pratense	...	...	...	Foxtail (3)
Andropogon (Sorghum) sudanense	...	...	...	Sudan Grass (2)
Avena sativa	...	...	...	Oat (6)
Bromus madritensis	...	...	...	Spear Grass (6)
B. maximus	...	...	...	Large Brome (25)
B. hordeaceus	...	...	...	Soft Brome (6)
B. sterilis	...	...	...	Sterile Brome (3)
Cynodon dactylon	...	...	...	Couch Grass
Festuca bromoides	...	...	...	Hair Grass (2)
F. Myuros	...	...	...	Silver Grass (6)
Hordeum jubatum	...	...	...	Barley Grass (2)
H. murinum	...	...	...	Barley Grass (22)
H. vulgare	...	...	...	Barley (2)
Lolium perenne	...	...	...	Perennial Rye-grass (7)
L. temulentum	...	...	...	Drake (7)
Paspalum dilatatum	...	...	...	Paspalum (2)
Setaria spp.	...	...	...	Millet (5)
Sorghum saccharatum	...	...	...	Sweet Sorghum (2)
Stipa spp.	...	...	...	Native Spear Grasses (2)
Triticum sativum	...	...	...	Wheat (2)
C. <i>Other Weeds</i> —				
*Bartsia viscosa	...	...	...	Yellow Weed (2)
Brassica spp.	...	...	...	Mustards (4)
*Cuscuta spp.	...	...	...	Dodder (2)
Cryptostemma calendulaceum	...	...	...	Cape Weed (2)
Erodium spp.	...	...	...	Crowfoot (2)
Hypochaeris glabra	...	...	...	Catsear (2)
H. radicata	...	...	...	Flatweed (4)
*Inula graveolens	...	...	...	Stinkwort
Juncus sp.	...	...	...	Native Rush (7)

Scientific Name.					Common Name.
C. <i>Other Weeds</i> —continued.					
Plantago lanceolata	...	...	...	...	Ribgrass (2)
P. major	...	...	...	...	Large Plantain
*Polygonum sp.	...	...	...	...	Bindweed
*Romulea rosea	...	...	...	...	Guildford Grass (9)
Rumex acetosella	...	...	...	...	Sorrel (4)
Rumex spp.	...	...	...	...	Docks (12)
Salvia sp.	...	...	...	...	Salvia (2)
Silene noctiflora	...	...	...	...	Catchfly (2)
Sonchus oleracea	...	...	...	...	Milk Thistle (6)
Tunica prolifera	...	...	...	...	Wild Pink (2)
xiii. Lotus corniculatus	...	...	...	...	Minor Birdsfoot Trefoil
Containing :—					
A. <i>Legumes</i> —					
Trifolium hybridum	...	...	...	...	Alsike Clover
T. pratense	...	...	...	...	Red Clover (2)
B. <i>Other Weeds</i> —					
*Asperula sp.	...	...	...	...	Squinancy Wort (2)
Lychnis alba	...	...	...	...	White Campion (2)
Plantago lanceolata	...	...	...	...	Rilgrass (2)
Rumex spp.	...	...	...	...	Docks
xiv. Lotus uliginosus	...	...	...	...	Lotus major
Containing :—					
A. <i>Legumes</i> —					
Lotus angustissimus	...	...	...	...	Birdsfoot Trefoil (7)
L. hispidus	...	...	...	...	Boyd's Clover (2)
L. corniculatus	...	...	...	...	Minor Birdsfoot Trefoil (2)
Trifolium arvense	...	...	...	...	Haresfoot Trefoil
T. dubium	...	...	...	...	Suckling Clover (4)
T. glomeratum	...	...	...	...	Cluster Clover (2)
T. hybridum	...	...	...	...	Alsike Clover (2)
T. pratense	...	...	...	...	Red Clover
T. repens	...	...	...	...	White Clover (10)
T. tomentosum	...	...	...	...	Woolly Clover
B. <i>Grasses</i> —					
Anthoxanthum odoratum	...	...	...	...	Sweet Vernal
Cynosurus cristatus	...	...	...	...	Crested Dogtail
Holcus lanatus	...	...	...	...	Yorkshire Fog (7)
Phleum pratense	...	...	...	...	Timothy (4)
Poa sp.	...	...	...	...	Annual Winter Grass
Setaria viridis	...	...	...	...	Pigeon Grass
C. <i>Other Weeds</i> —					
*Asperula sp.	...	...	...	...	Squinancy Wort (2)
*Cuscuta sp.	...	...	...	...	Dodder
Geranium sp.	...	...	...	...	Crowfoot
Juncus sp.	...	...	...	...	Rush
Plantago lanceolata	...	...	...	...	Ribgrass (8)
P. major	...	...	...	...	Large Plantain (2)
Prunella vulgaris	...	...	...	...	Selfheal (2)
Rumex acetosella	...	...	...	...	Sorrel (10)
Rumex spp.	...	...	...	...	Docks (2)
Silene noctiflora	...	...	...	...	Catchfly (3)
Spargula arvensis	...	...	...	...	Spurry (2)

Scientific Name.					Common Name.
<b>xv. <i>Lotus hispidus</i> ... ..</b>					Boyd's Clover
Containing :—					
A. <i>Grasses</i> —					
	<i>Agrostis vulgaris</i> ... ..				Red Top
	<i>Aira caryophyllea</i> ... ..				Silvery Grass
	<i>Festuca Myuros</i> ... ..				Silver Grass
	<i>Holcus lanatus</i> ... ..				Yorkshire Fog (3)
	<i>Phleum pratense</i> ... ..				Timothy
B. <i>Other Weeds</i> —					
	<i>Amaranthus retroflexus</i> ... ..				Pigweed
	<i>Hypochoeris radicata</i> ... ..				Flatweed
	<i>Plantago lanceolata</i> ... ..				Ribgrass (3)
	<i>Rumex acetosella</i> ... ..				Sorrel (2)
	<i>Rumex spp.</i> ... ..				Docks (2)
<b>xvi. <i>Vicia spp.</i> ... ..</b>					Vetches
Containing :—					
A. <i>Grasses</i> —					
	<i>Avena sativa</i> ... ..				Oat (2)
	<i>Hordeum vulgare</i> ... ..				Barley
	<i>Triticum sativum</i> ... ..				Wheat
B. <i>Other Weeds</i> —					
	* <i>Galium aparine</i> ... ..				Cleavers
	* <i>Lychnis Githago</i> ... ..				Corncockle
<b>xvii. <i>Pisum arvense</i> ... ..</b>					Field Peas
Containing :—					
A. <i>Legumes</i> —					
	<i>Medicago denticulata</i> ... ..				Burr Medic
B. <i>Grasses</i> —					
	<i>Avena sativa</i> ... ..				Oat
	<i>Hordeum vulgare</i> ... ..				Barley
C. <i>Other Weeds</i> —					
	<i>Fumaria officinalis</i> ... ..				Fumitory
	<i>Galium aparine</i> ... ..				Cleavers
<b>xviii. <i>Glycine max</i> ... ..</b>					Soy Bean
Containing :—					
	* <i>Xanthium spp.</i> ... ..				Burrs (10)
<b>8. LINACEAE.</b>					
<b>i. <i>Linum usitatissimum</i> ... ..</b>					Linseed (Flax)
Containing :—					
A. <i>Grasses</i> —					
	<i>Setaria glauca</i> ... ..				Pigeon Grass
	<i>Triticum sativum</i> ... ..				Wheat
B. <i>Other Weeds</i> —					
	<i>Apium sp.</i> ... ..				Celery
	<i>Brassica spp.</i> ... ..				Mustards (12)
	<i>Chenopodium album</i> ... ..				Mexican Spinach (2)
	<i>Commelina sativa</i> ... ..				False Flax
	<i>Raphanus sativa</i> ... ..				Radish
	<i>Rumex spp.</i> ... ..				Docks (3)
	<i>Scabiosa sp.</i> ... ..				Scabious
	<i>Spergula arvensis</i> ... ..				Spurry

Scientific Name.					Common Name.
<b>9. UMBELLIFERAE.</b>					
<b>i. <i>Apium graveolens</i> var <i>dulce</i></b> ... .. Celery					
Containing :—					
A. <i>Grasses</i> —					
<i>Setaria italica</i> ... ..					Italian Millet (3)
B. <i>Other Weeds</i> —					
<i>Pteris</i> sp. ... ..					Ox Tongue
<i>Rumex</i> sp. ... ..					Dock
<b>ii. <i>Petroselinum sativum</i></b> ... .. Parsley					
Containing :—					
<i>Amaranthus retroflexus</i> ... ..					Pigweed (3)
<i>Brassica</i> spp. ... ..					Mustards (2)
<i>Plantago lanceolata</i> ... ..					Ribgrass
<b>iii. <i>Pastinacea sativa</i></b> ... .. Parsnip					
Containing :—					
<i>Brassica nigra</i> ... ..					Black Mustard (3)
<i>Hordeum vulgare</i> ... ..					Barley
<b>iv. <i>Daucus carota</i></b> ... .. Carrot					
Containing :—					
<i>Allium</i> sp. ... ..					Onion
<i>Amaranthus retroflexus</i> ... ..					Pigweed
<i>Plantago lanceolata</i> ... ..					Ribgrass (3)
<i>Polygonum aviculare</i> ... ..					Wireweed
* <i>P. convolvulus</i> ... ..					Bindweed (2)
<i>Rumex acetosella</i> ... ..					Sorrel (5)
<i>Rumex</i> spp. ... ..					Docks
<b>10. PLANTAGINACEAE.</b>					
<b>i. <i>Plantago lanceolata</i></b> ... .. Ribgrass					
Containing :—					
A. <i>Legumes</i> —					
<i>Trifolium dubium</i> ... ..					Suckling Clover
T. <i>pratense</i> ... ..					Red Clover
T. <i>repens</i> ... ..					White Clover
B. <i>Grasses</i> —					
<i>Cynosurus cristatus</i> ... ..					Crested Dogtail
<i>Holcus lanatus</i> ... ..					Yorkshire Fog
<i>Lolium perenne</i> ... ..					Perennial Rye-grass
<i>Phalaris minor</i> ... ..					Canary Grass
C. <i>Other Weeds</i> —					
<i>Brassica</i> sp. ... ..					Mustard
<i>Rumex acetosella</i> ... ..					Sorrel
<b>11. COMPOSITAE.</b>					
<b>i. <i>Lactuca sativa</i></b> ... .. Lettuce					
Containing :—					
<i>Amaranthus retroflexus</i> ... ..					Pigweed (2)
<i>Chenopodium album</i> ... ..					Mexican Spinach
<i>Juncus</i> sp. ... ..					Rush
<i>Roseda luteola</i> ... ..					Wild Mignonette
<i>Stellaria media</i> ... ..					Chickweed

## COOL DAIRIES FOR COOL CREAM.

M. CULLITY, Agricultural Adviser.

During the past summer many suppliers of cream found that it was again difficult to keep their cream up to choice quality. For some reason that baffles them, in a great many cases their cream is often second grade or else what is known as "border-line cream." It frequently happens that the farmer has cream of this latter type, but knows nothing of it if the grader decides it is good enough to use in the first grade vat. Just good enough is not good enough, and it appears to be very difficult to bring this home to the dairy farmer. Various causes are at work to bring about this lowering to or below "border-line" standard, and it is my intention in these notes to draw attention to one factor which has a considerable effect, although in many cases the application of this factor is like liming land that is sour through faulty drainage. The sourness is corrected, but the cause of it is not touched. Similarly with the subject to be discussed, the matter of the production of clean milk and cream, the cleanliness of utensils, the health of the herd, etc., should be treated first; but it seems opportune to me, while pointing to the necessity for cleanliness throughout all phases of the production of cream, to draw attention to the safe-guarding effect of cooling the cream immediately after separation and the keeping of it cool.

Very few of our farmers now follow the faulty practice of separating warm cream into a can of cold cream, because it has been proved to them that this practice is very detrimental to quality. They know that the result of raising the temperature of the cool cream is to facilitate the multiplication of the bacteria therein, with the result that the cream develops cheesy, rank or unclean flavours. The bacteria that are in cream have an optimum temperature for their multiplication, above which the rate of division declines till a point is reached at which they are destroyed. This fact is utilised in pasteurisation. Also below the optimum, the further the temperature is reduced the slower the rate of increase becomes. This means that the cooler cream is kept the slower bacterial change will carry on. Also the quicker the cream is cooled, the less bacterial increase will occur. It might be necessary to say that of all the flavours to which cream is prone, those due to bacterial change are among the worst.

To give an indication of how quickly bacteria will increase their rate of multiplication with a rise in temperature, the following figures are useful:—

Number Bacteria c.c. at outset.	In 12 hours at 50 deg.	In 12 hours at 70 deg.	In 50 hours at 50 deg.	In 50 hours at 70 deg.	No. of hours before Curd- ling at 50 deg.	No. of hours before Curd- ling at 70 deg.
46,000	39,000	249,500	156,000	542,000,000	190	56
47,000	44,800	360,000	127,500	792,000,000	289	36
50,000	35,000	800,000	160,000	36 hours 2,500,000,000, 42 hours	172	42

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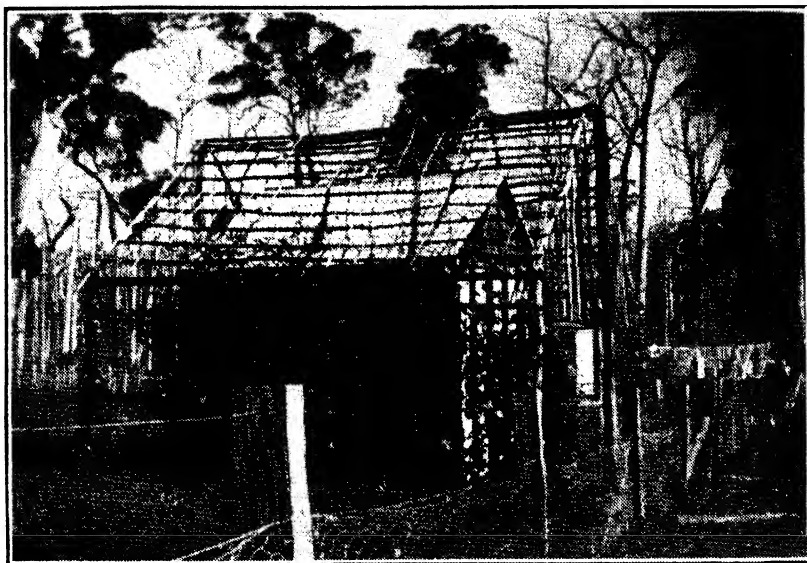
Our concern is now to illustrate how this cooling may be brought about. (See "Cooling of Milk and Cream," by G. K. Baron-Hay, Western Australian Department of Agriculture *Journal*, December, 1930.)

To those farmers who have a supply of cold water laid on to the dairy, the problem is simple. There are on the market various small cooling devices of the

type illustrated in Fig. 1 of Mr. Baron-Hay's article referred to above, which are very efficient. In appearance these remind one of the household washboard. Where the ribs are in the washboard are thin tubes through which cold water is flowing. The cream is received from the outlet of the separator into a tray from which it flows in a thin layer over the exterior of these tubes. The heat of the cream is taken up by the water which passes away.

This method also has another advantage in aeration. The passage of this thin layer of cream would have the effect of allowing any volatile flavours to escape.

The temperature of the cream so cooled should be maintained. This is quite easily done by having a tub in which the cream cans can be placed, and which is kept continuously full of cold water. Better still, where cold water can be kept running, as in Fig. 11., "Cooling of Milk and Cream," by G. K. Baron-Hay, Western Australian Department of Agriculture *Journal*, December, 1930.



Trellis carrying vine erected over dairy.

W. J. Reynolds, Manjimup.

Of course there is a very serious objection to this for those who have not a good supply of water laid on, or who cannot afford a cooler of the type illustrated. For these a modification is suggested which, though not as efficient as that just described, is very much better than not cooling at all. This is in having the vessel with the freshly separated cream stand in a larger vessel of cold water. This should be changed two or three times during cooling, as it takes up the heat from the cream. This method, though crude, has the effect of reducing the cream temperature five times as fast as where air cooling only is used. The cream cans can also be kept in a tub of cold water.

Another factor of importance is the dairy. Often one finds these stuffy, ill-ventilated and warm; some even hot. These types of dairies have an undoubtedly bad effect on flavour. The cream absorbs the stuffiness and mustiness, and it can be easily detected by the grader. The warm atmosphere has its effect in keeping up the temperature of the cream as instanced previously. How, then, to remedy



this condition? The first step necessarily will be in arranging ventilation and removing any causes of mustiness. There should be no necessity here for pointing out that a dairy is for the storage of milk and cream, and that other substances, vegetables, meat, chaff, etc., should be kept elsewhere.



Dairy surrounded by lucerne trees.  
D. Hunter (sen.), Barronhurst.

To correct the heat various methods are utilised, but the most successful have been where a trellis has been built completely over the dairy, and vines (grapes or passion) trained over it. Any form of creeper giving summer shade would be efficient. This trellis to be quite successful has to be built away from the walls, usually two feet, and about the same distance being kept between the roof and the trellis, thus allowing for shade and a draught of air continuously between the trellis and the dairy. The two illustrations will give an idea of how to do this better than any description. Others, like D. Hunter, plant trees nearby to shelter the building, getting very good results (see illustration). These have been convinced of the necessity for cool dairies, and have taken steps to provide the so necessary coolness. Why do so many others neglect it? Their methods of production are not so superior that their cream does not need to be cool. The time is now approaching when the quality of the cream received at the factories will be more closely checked, so that it will behave those farmers who wish to obtain the highest price for their cream to pay more attention to the details. While the details are neglected, the quality of the cream will be variable.

## TRIALS WITH RHENANIA PHOSPHATE FOR WHEAT GROWING, 1930, AT THE MERREDIN EXPERIMENT FARM AND THE WONGAN HILLS LIGHT LANDS FARM.

I. THOMAS, Superintendent of Wheat Farms.

Rhenania Phosphate is a phosphatic fertiliser manufactured by the Kali-Chemie Company, Berlin, Germany. It is a high grade ammonium citrate soluble fertiliser, containing 28.4 per cent. ammonium citrate soluble phosphoric acid, and has given satisfactory results in Germany. It has also proved valuable for rice culture in Japan and there is a considerable export to that country and also to Brazil, Chili, Guatemala, etc.

Owing to the generosity of the manufacturers, a quantity of this fertiliser was made available for trials in this State. The cost of this fertiliser in Germany is £5 3s. 9d. per kilogram, the landed cost in Perth being £8 10s. per kilogram (2,204.6 lbs.). This price is equal to approximately £8 13s. a ton. The local price of superphosphate, which contains 22 per cent. phosphoric acid, is £4 10s. per ton. For comparative purposes the unit value of these fertilisers, in Perth, are respectively—

Rhenania Phosphate	..	..	..	6/0
Superphosphate	..	..	..	4 1

A portion of this fertiliser was made available to this Branch for trials with wheat, and experiments were laid down at both the Merredin Experiment Farm and the Wongan Hills Light Lands Farm.

For the purpose of the experiment three plots were required, viz.:—

Plot 1.—Received an application of 150 lbs. of Rhenania Phosphate per acre.

Plot 2.—Received an application of 150 lbs. of Superphosphate per acre (control plot).

Plot 3.—Received an application of 110 lbs. of Rhenania Phosphate per acre.

Plots 1 and 2 thus received the same weight of fertiliser per acre, and Plots 2 and 3 the equivalent quantities of phosphoric acid.

The plots, which were each one-eighth of an acre in area, were repeated five times, the fertiliser being applied with the seed at the time of planting, and the resulting crop was harvested for grain.

### TRIALS AT THE MERREDIN EXPERIMENT FARM.

The land on which the experiment was conducted was typical heavy forest country which originally carried a forest of salmon gum and gimlet and which has been in cultivation for many years. The land was ploughed with a disc plough in June, 1929, and was reploughed in August and springtyne cultivated after rain in March. Prior to seeding on 13th May it was cultivated and cross cultivated with a tandem disc implement. The variety Gluyas Early was planted at the rate of 45 lbs. per acre.

The rainfall during 1930, together with 19 years average, is as follows:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1930 ...	...	1	281	186	40	363	137	184	65	34	823	1	41	1,333
Average 19 years	55	56	125	79	130	195	188	140	93	75	821	44	54	1,234

The results obtained are as follows:—

#### MERREDIN FARM.

##### RHENANIA PHOSPHATE EXPERIMENT.

Planted on 13th May, 1930.

Variety—Gluyas Early.

Seed—45lbs. per acre.

Rate of Application of Phosphates per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
150lbs. Rhenania Phosphate	bus. lbs. 30 56	bus. lbs. 28 56	bus. lbs. 29 44	bus. lbs. 30 0	bus. lbs. 29 20	bus. lbs. 29 47	% 97
150lbs. Superphosphate ...	31 52	29 52	31 12	30 16	30 8	30 40	100
110lbs. Rhenania Phosphate	30 0	27 44	30 0	27 36	28 8	28 42	94

On this farm it was not possible to obtain a piece of land to which no phosphatic fertiliser had previously been applied.

#### TRIALS AT THE WONGAN HILLS LIGHT LANDS FARM.

At this farm the experiment was conducted on land which, prior to ploughing in 1929, was still in its natural state, the vegetation being chiefly what is known as smoke bush, and the soil is of a light sandy nature.

The working of the land in preparation for the experiment was as follows:— During June and July, 1929, it was ploughed with a disc cultivating plough, and in September and October was cross cultivated with the same implement. In January it was scrub-raked and lightly cultivated with a disc implement in March. It was then tandem disc cultivated prior to seeding. The experiment was planted with the standard midseason variety Nabawa on 23rd April.

The rainfall for Wongan Hills for 1930 and the five years' average is as follows:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1930 —	7	NH	53	92	66	367	321	149	90	55	1,048	1	98	1,290
Average 5 years	27	47	112	65	144	282	294	133	77	81	1,011	37	30	1,329

The growth of the plots receiving an application of Rhenania Phosphate was inferior throughout the season compared with the control plots, and this difference was more marked towards maturity, the control plots ripening about ten to twelve days earlier than the Rhenania plots.

The results were as follow:—

WONGAN HILLS LIGHT LANDS FARM.

RHENANIA PHOSPHATE EXPERIMENT.

Planted on 23rd April, 1930.

Variety—Nabawa.

Seed—45lbs. per acre.

Rate of Application of Phosphates per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
150lbs. Rhenania Phosphate	bus. lbs. 9 12	bus. lbs. 9 20	bus. lbs. 9 36	bus. lbs. 9 20	bus. lbs. 10 8	bus. lbs. 9 31	% 55
150lbs. Superphosphate ...	17 36	14 48	17 44	17 12	17 12	17 18	100
110lbs. Rhenania Phosphate	7 52	8 32	8 16	9 12	8 16	8 26	49

The results from this farm, although for one year only, show a significant difference in favour of the superphosphate.

Of the two experiments, that at Wongan Hills is the more striking, as a better comparison can be made between the availability of the two fertilisers because of the low initial phosphoric acid content of the soil and also because it was conducted on virgin land.

It must be borne in mind that there was a considerable residual effect of phosphoric acid at the Merredin Farm, as it was found impossible to carry out the experiment on a piece of land which had not previously received a dressing of a phosphatic fertiliser.

From the results of the trials at both farms, it is unlikely that Rhenania Phosphate will displace superphosphate for wheat growing.

## THE M. T. PADBURY TROPHY COMPETITION.

### I. THOMAS, Superintendent of Wheat Farms.

This competition was inaugurated as the result of a generous donation made by Mr. M. T. Padbury, President of the Primary Producers' Association, a past President of the Royal Agricultural Society, and a prominent pioneer farmer of this State. The allocation of the funds has been so arranged that a replica of the main shield is awarded to the winner each year of the competition, *i.e.*, the competitor who produces the highest acre yield of wheat per inch of rainfall during the growing season (May 1st to October 31st).

The conditions under which this competition is being conducted are as follow:—

1. The competition will commence with the 1930-31 harvest and continue for a period of 10 years. At the end of that period the trophy will be awarded to the competitor who has taken part in the competition for at least five years, and who obtains the greatest mean average acre yield per inch of rainfall during the conventional growing period. The mean average yield will be computed

from the results of the five seasons in which the competitor produced the highest acre yield per inch of rainfall during the growing period. In the event of a tie the competition will continue between the leading competitors until an advantage is gained by one of them.

2. The conventional growing period for any year will be that decided upon and announced by the Royal Agricultural Society. For the first year and until further notice it has been decided that it will be from May 1st to October 31st, inclusive.

3. Until the end of the competition the trophy will be in the custody of the Royal Agricultural Society, and will be displayed at any agricultural exhibition held by that society.

4. Each year the competitor who obtains the best average acre yield per inch of rainfall during the conventional growing period will be awarded a replica of the trophy. His name will also be inscribed upon a small shield affixed to the trophy.

5. The rainfall upon which the award will be made will be determined by the Commonwealth Meteorologist from the district records, and his decision in this matter will be final.

6. The competition will be limited to those farmers who harvest at least 200 acres of wheat for grain. Where a competitor is financially interested in the crops grown on one or more farms he will be required to supply details regarding the production and marketing of the crops on same, and though usually the award will be made upon the results from the farm nominated by the competitor, yet the Royal Agricultural Society may require that the crops on these farms be included in the competing area.

7. The average yield will be ascertained from the total area—including self-sown crops—harvested for grain and determined from the actual amount of wheat sold as shown by the delivery dockets, plus the amount retained for seed, for home use, or for any other purpose.

8. The method of judging will be as follows:—At a convenient time the area harvested for grain will be measured and the quantity of wheat on hand ascertained. On or before January 31st, the farmer will be required to furnish the judge with a sworn declaration as to the quantity of wheat sold from the competing holding or holdings, and the amount retained for seed and other purposes; the statement regarding the amount sold to be supported by agents' dockets. The judge, after satisfying himself as to the correctness of this statement, will compute the average yield per acre per inch of rainfall during the growing period from the information received.

9. The judge will be appointed by the Director of Agriculture, and his decision will be final.

10. Nominations for this competition will be received by the Royal Agricultural Society up to the 31st October each year.

The acre yields are highly meritorious, and in the case of the winner, 3 bushels 23 lbs. per inch of rainfall constitutes an official record for this State. The previous record was held by Mr. J. McDonald, the winner of the Bateman Cup Competition, 1929/30 season, with an acre yield of 3 bushels 22 lbs. per inch of rainfall.

The results for last season, the first in the competition, are set out below:—

M. T. PADBURY TROPHY COMPETITION, 1930.

Competitor.	Address.	Rainfall during Growing period.	Area Harvested.	Yield.					
				Gross.		Average per Acre.		Average per lin. Growing period Rain.	
		points.	acres.	bus.	lbs.	bus.	lbs.	bus.	lbs.
Williams, F. A. ...	Mangowine <i>via</i> Nungarin	799	337	9,126	50	27	5	3	23
Pascoe Bros. ...	Yalbarrin ...	987	299	9,537	0	31	54	3	14
Haggerty, H. J. ...	Erikin ...	899	349	8,914	24	25	33	2	51
Barnett, L. T. C. ...	North Wolgoolan	1,062	468	13,908	28	29	43	2	48
Leah, J. H., & Son	Ardath ...	1,053	406	11,737	46	28	55	2	45
Cusbert, L. C. ...	Bruce Rock	987	480	12,118	16	25	15	2	44
Manuel, C. J. ...	Mukinbudin ...	893	248	6,043	5	24	22	2	44
Atkins, F. M., & J. L.	Yanoning Rock ...	796	438	9,362	17	21	23	2	41
Smith, C. & A. H.	Yalbarrin ...	987	1,383	35,890	38	25	57	2	38
Strange, P. A. ...	Yarding ...	1,053	432	11,856	55	27	27	2	36
Snell, C. & Son ...	Nangeenan ...	894	428	9,495	2	22	11	2	29
Craigie, J. ...	Yarding ...	1,053	563	14,632	46	25	59	2	28
Gilham, F. ...	Bencubbin ...	861	496	10,517	22	21	12	2	28
Hammond, J. D. ...	Kollerberrin ...	845	370	7,605	10	20	33	2	26
Tibbs, J. A. ...	Bruce Rock	1,047	345	8,699	53	25	13	2	25
Henderson, late J. H.	Gnarwing ...	1,142	582	15,668	51	26	55	2	21
Smith, C., & Sons	Yarding ...	1,053	2,414	59,782	37	24	46	2	21
Creagh Bros., Ltd.	Nungarin ...	840	1,172	22,992	45	19	37	2	20
Lohoar, W. ...	Borden ...	984	262	5,866	40	22	23	2	16
Allen Bros. ...	Cent. Kumninin	1,047	700	16,003	17	22	52	2	11
Jacob, H. D. ...	Erikin ...	899	393	7,478	32	19	16	2	9
Reichett, F. W. ...	North Burracoppin	945	1,244	25,006	33	20	6	2	8
Morecombe, P. T. ...	Waddy Forest ...	1,208	490	12,191	7	24	53	2	4
Bishop, H. F. ...	Lake Grace ...	1,260	287	7,272	48	25	20	2	1
Nixon, T., & Sons	Kalannie ...	1,066	4,086	85,040	0	20	49	1	57
Bremner, J. R., & Sons	Corrigin ...	1,080	1,172	24,361	1	20	47	1	55
Carter, H. R. ...	Three Springs ...	1,219	318	7,412	11	23	19	1	55
Horsman, H., & Sons	Bilbarin ...	1,080	422	8,588	24	20	21	1	53
Stewart, W. B. ...	Gnowangerup ...	1,225	289	6,578	26	22	46	1	52
White, R. H. ...	Gnowangerup ...	1,225	245	5,535	8	22	36	1	51
Barr, D. F. ...	Shackelton ...	1,137	485	10,053	56	20	44	1	49
Prowse, E. W. ...	Doodlakine ...	843	660	9,485	6	14	22	1	42
Carter, J. S., & G. T.	Benjaberring ...	901	554	8,393	29	15	9	1	41
Garrett, G. ...	Ardath ...	1,122	642	11,821	57	18	25	1	38
Stewart, T. D. ...	Gnowangerup ...	1,225	209	3,751	15	17	57	1	28
Cowan, C. W. ...	E. Narembreen ...	1,026	883	13,394	19	15	10	1	28
Clark, R. W. ...	Carnamah ...	1,515	687	14,190	9	20	39	1	22
Stevenson, K. J. O.	Watheroo ...	1,571	621	12,360	43	19	54	1	16

## EXPERIMENT WITH SHEEP-BRANDING FLUIDS.

### PROJECT No. 34.

R. P. ROBERTS, B.Sc.(Agric.), Agricultural Adviser.

This article has been compiled by the writer from information supplied by Mr. H. J. Hughes, Principal of the Muresk Agricultural College, and Messrs. F. L. Shier and J. H. Langfield, Managers of the Chapman and Merredin Experiment Farms, respectively.

In June, 1929, a number of different types of sheep-branding fluids were received for trial from the British Research Association for the Woollen and Worsted Industries.

These were forwarded to the Merredin and Chapman Experiment Farms and to the Muresk Agricultural College for trial. Climatic conditions at these three centres are very similar, the summers being hot and dry and the winters mild and wet.

The Chapman Experiment Farm is situated in the extreme northern portion of the wheat belt, about 30 miles from the coast. The average rainfall is 18.17 inches. The soil is mainly a red sandy loam.

Muresk Agricultural College is on the western edge of the central wheat belt, 65 miles from the coast. The soil varies in character from sand to clay. The average annual rainfall at Northam, nine miles distant, the closest point at which records have been kept, for 50 years is 17.12 inches.

The Merredin Experiment Farm is located in the East-Central wheat belt, 168 miles from the coast. The average annual rainfall is 12.27 inches, and the soil is mostly a red clay loam.

At each of these centres experiments were carried out with the object of determining—

- (a) the permanency of the various wool-marking fluids under natural conditions, and
- (b) the effect upon the wool.

The procedure was the same at each station.

At least 10 merino sheep, carrying different types of wool, were marked immediately after shearing in September, 1929. Observations regarding durability were made throughout the year. The results of these observations at each of the farms are as follow:—

*Chapman Experiment Farm.* Sheep branded C & N.

Types of fluid used—

No. 8—Red.

No. 17—Blue.

No. 19—Green.

Owing to accumulation of dust and grease in the tip the colours were not distinguishable two months after application without opening up the wool. The markings themselves remained clear in outline for a period of about six months.

After that the red and green gradually became indecipherable, but in the case of the blue fluid it was possible, on close inspection, to read the marks up to nine months after application.

When examined at shearing time the following year (September, 1930), all sheep that had been branded with the blue fluid showed traces of the markings, though it was not possible to decipher exactly what the brand was. Many of the sheep branded with the green fluid showed traces of a brand, but others showed no sign whatever.

Of the sheep which had been branded with the red fluid, only two showed any trace of a brand.

The experiment showed that the blue fluid (17) was more lasting than either the green (19) or the red (8). The green lasted fairly well, but the red was quickly washed away with the winter rains.

*Merredin Experiment Farm.* Sheep branded N↑N.

Types of fluid used—

No. 8—Red.

No. 15—Red.

Owing to accumulation of dust and grease in the tip the colours were not distinguishable two months after application without opening the wool.

The outline of the markings remained clear for about six months. With the beginning of winter they faded out rapidly.

At shearing, in September, 1930, no traces of the brands could be found.

*Muresk Agricultural College.* Sheep branded M↑C.

Types of fluid used—

No. 17—Blue.

No. 18—Red.

No. 19—Green.

A tin of No. 15 was also forwarded, but was not used in the experiment.

Owing to accumulation of dust and grease in the tip, the actual colours soon became indistinguishable, without opening up the wool. The brands remained clear, however, in all weathers, and were permanent. They were not affected by dipping in November, 1929.

Samples of the branded wool were taken from the sheep immediately prior to shearing in September, 1930. These were passed to Mr. McCallum, Sheep and Wool Inspector, for examination, and were scoured with the exception of the small duplicates enclosed. It was found impossible to remove the marks by scouring. This seriously detracts from the value of the wool both from the grower's and the buyer's point of view.

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A summary of results is given below:—

Colour.	Reference No.	Location of Trial.	Duration of Colour.	Durability of the Marking.	Condition at Shearing in September, 1930, one year after application.	—
Red ...	8	Merredin Experiment Farm... Chapman Experiment Farm	<p>Owing to dust and grease the colour not distinguishable two months after application without opening up the tip</p>	Fairly clear in outline till beginning of winter, then faded out rapidly	No trace	<p>Samples of branded wool from Muresk were scoured with soap and warm water one year after application, but the marks could not be washed out.</p>
Red ...	15	Merredin Experiment Farm...		Fairly clear in outline till beginning of winter, then faded out rapidly	No trace	
Blue ...	17	Muresk Agricultural College... Chapman Experiment Farm		At Muresk—Permanent Remained fairly clear at Chapman for seven months longer than the other colours	At Muresk—Colour plainly visible on opening wool At Chapman—Plainly visible on all sheep, though outline generally undecipherable	
Red ...	18	Muresk Agricultural College...		Permanent ... ..	Colour plainly visible on opening wool	
Green ...	19	Muresk Agricultural College... Chapman Experiment Farm		At Muresk—Permanent At Chapman—Fairly clear till beginning of winter	At Muresk—Colour plainly visible on opening wool At Chapman some sheep showed signs of having been branded; on others no trace.	

## DISTRICT CHALLENGE SHIELD WHEAT YIELD COMPETITION.

I. THOMAS, Superintendent of Wheat Farms.

The past season marked the end of this competition which commenced in 1928 and continued for a period of three years. The progressive results have appeared in previous June issues of this Journal, and these have now been incorporated in the final figures.

The detailed conditions under which the competition was conducted have previously been published. The main feature of the competition, however, was that it was not for individual farmers, but for a team of five farmers nominated by a responsible local body in different districts throughout the Wheat Belt. The awards were made on yields only, and the team which obtained the highest average yield per acre over the three years was adjudged the winner.

The judging was attended to by the officers of the Wheat Branch of the Department of Agriculture, who ascertained by measurement the areas stripped for grain by the competitors, and computed the yields from the amount of wheat delivered to the merchants and that kept on the farm.

The trophies were presented for competition by the Cuming Smith-Mt. Lyell Farmers Fertilisers Co., Ltd. The main trophy is the Challenge Shield upon which is inscribed, permanently, the names of the winning society and the names of the farmers comprising the team entered, and also the names of the Districts and the personnel of the teams which have won it in any particular year during the period of the competition. In addition to the shield, the donors presented each member of a winning team with a small replica of the shield, on which is inscribed the name of the District winning the yearly competition, and each member of the team.

For the first year of the competition (1928-29) seventeen teams complied with the conditions. The first three places were filled as follows :—

1. Yandanooka ....	....	26 bus.	17 lbs.
2. Gnowangerup ....	....	26 „	14 „
3. Borden ....	....	24 „	29 „

The total area harvested by the 17 teams (85 farmers), was 40,978 acres, which yielded 676,457 bushels, an average acre yield of 16 bushels 30lbs. The highest individual average yield for this year was that of Mr. P. C. Neville, of Yandanooka, who averaged 31 bushels 38lbs. from 313 acres. This yield created a new State official record, the previous record being 26 bushels 56lbs., established in 1925, by Mr. T. Richards, South Caroling.

In the second year of the competition (1929-30), twelve teams complied with the conditions. The three leading teams were as follows :—

1. Gnowangerup ....	....	30 bus.	34 lbs.
2. Borden ....	....	25 „	39 „
3. Yandanooka ....	....	24 „	54 „

The total area harvested by the twelve teams (60 farmers) was 32,741 acres for a gross yield of 611,192 bushels, an average acre yield of 18 bushels 40lbs. Mr. J. McDonald, of Gnowangerup, produced the highest average yield in 1929-30, averaging 36 bushels 41 lbs. from 279 acres. This eclipsed the official State record created last year by Mr. P. C. Neville of Yandanooka.

In the final year of the competition eight teams competed, the three leading competitors being :—

1. Bruce Rock	... ..	26 bus.	41 lbs.
2. Yandanooka	... ..	24 „	7 „
3. Nungarin	... ..	22 „	23 „

The total area harvested by the eight teams was 16,779 acres for a gross yield of 366,400 bushels 32 lbs., an average acre yield of 21 bushels 50 lbs. The highest individual average yield per acre in the final year of the competition was produced by Messrs. Pascoe Bros., of Bruce Rock, who averaged 31 bushels 54 lbs. from 299 acres.

The detailed results for 1930-31, the final year of the competition, are as follows :—

District.	Members of Team.	Acreage.	Yield.			
			Gross.		Average per acre.	
			bus.	lbs.	bus.	lbs.
Bruce Rock	Pascoe Bros.	299	9,537		31	54
	Strange, P. A.	432	11,856	55	27	27
	Craigle, J.	563	14,632	46	25	59
	Smith, C. & A. H.	1,883	35,890	38	25	57
	Tibbs, J. A.	345	8,699	53	25	13
		3,022	80,617	12	26	41
Yandanooka	Eckermann, H. W.	246	7,335	31	29	49
	Saunders, W.	238	6,351	3	26	41
	Quartermaine, R.	230	5,377	44	23	23
	Fyfe, G. D.	200	4,538	45	22	42
	Downes, C. W.	264	4,804	12	18	12
		1,178	28,407	15	24	7
Nungarin	Williams, F. A.	337	9,126	50	27	5
	McDonnell & Hinkley	790	19,324	23	24	28
	Manuel, C. J.	248	6,043	5	24	22
	Waterhouse, H. H.	514	11,061	38	21	31
	Craugh, Bros.	1,172	22,992	45	19	37
		3,061	68,548	36	22	23
Gnowangerup	Stewart, W. B.	289	6,578	26	22	46
	White, R. H.	245	5,535	8	22	36
	Lohar, W.	262	5,866	40	22	23
	McDonald, J.	262	5,577	42	21	17
	Stewart, T. D.	209	3,751	15	17	57
		1,267	27,309	11	21	33
Tammin	Nottage, R. B.	310	7,812	28	25	12
	Mann, J. W.	543	11,804	29	21	44
	Hocking, H. R.	395	8,506	49	21	32
	Uphill, G.	1,037	20,197	31	19	29
	Mackin, C. C.	855	15,154	44	17	43
		3,140	63,476	1	20	13
Three Springs	Stokes, N. E.	268	7,137	0	28	38
	Carter, R. & Sons	318	7,412	11	23	19
	Glyde, R. S.	204	3,770	0	18	29
	Bastain, A.	536	9,668	0	18	2
	Hunter, J.	475	7,977	0	16	48
		1,801	35,964	11	19	58
Moulyinning	Cohen & Gibbs	230	5,458	9	23	44
	Clark Bros.	379	8,275	36	21	50
	Mott, H.	222	4,238	0	19	5
	Carwardine, F.	388	7,056	30	18	25
	Mott, C.	458	7,505	56	16	23
		1,672	32,534	11	19	28
Borden	Murray, W. W.	465	9,860	14	21	12
	McLennan's Est.	423	8,369	12	19	47
	West, F. C.	249	4,801	9	17	16
	Moir, J. A.	228	3,477	55	15	15
	Finney, G.	273	3,585	25	12	57
		1,638	29,543	55	18	2

Gross Yield, 3 years—101,982 bus. 3 lbs.  
Gross acreage, 3 years—4,517 acres.  
Final average per acre over 3 years—22 bus. 35 lbs.

District.	Members of Team.	Acreage.	Yield.			
			Gross.		Average per acre.	
Bruce Rock, 1930	Pascoe Bros. ... ..	299	bus.	lbs.	bus.	lbs.
	Strange, P. A. ... ..	432	7,587	0	31	54
	Craizle, J. ... ..	563	11,856	55	27	27
	Smith, C. & A. H. ... ..	1,383	14,632	46	25	59
	Tibbs, J. A. ... ..	345	35,890	38	25	57
			8,699	53	25	13
		3,022	80,017	12	26	41
1929	Smith, C. & Sons ... ..	2,765	59,972	0	20	36
	Ellis, M. P. & E. G. ... ..	296	5,538	29	18	42
	Garret, G. ... ..	697	12,973	28	18	37
	Cusbert, L. G. ... ..	559	9,294	44	16	38
	Muntz, J. N. & Son ... ..	379	5,839	36	15	24
		4,696	90,618	17	19	18
1928	Mann, R. ... ..	543	9,620	0	17	43
	Haggerty, H. J. ... ..	383	5,724	0	17	11
	Stone, S. B. ... ..	540	7,170	0	16	59
	Abraham, J. M. ... ..	665	10,165	0	15	17
	Tibbs, J. A. ... ..	318	4,821	0	15	10
		2,399	39,500	0	16	28

Gross yield, 3 years—210,735 bus. 29 lbs.

Gross acreage, 3 years—10,117 acres.

Final average per acre over 3 years—20 bus. 50 lbs.

Three Springs, 1930	Stokes, N. F. ... ..	268	bus.	lbs.	bus.	lbs.
	Carter, R. & Sons ... ..	318	7,187	0	26	38
	Glyde, K. S. ... ..	204	7,412	11	23	19
	Bastian, A. ... ..	530	3,770	0	18	29
	Hunter, J. ... ..	475	9,668	0	18	2
			7,977	0	16	48
		1,801	35,964	11	19	58
1929	Bastian, A. ... ..	333	8,494	0	25	30
	Carter, R. & Sons ... ..	277	6,997	0	25	16
	Thomas, C. F. & Sons ... ..	526	11,512	12	21	53
	Conlins, A. H. ... ..	700	14,204	0	20	17
	Strutton, A. R. ... ..	546	10,216	3	18	43
		2,382	51,423	15	21	35
1928	Bastian, A. ... ..	283	6,953	0	24	34
	Glyde, K. S. ... ..	328	6,806	0	20	45
	Thomas & Sons ... ..	537	11,692	0	20	37
	Carter, R. & Sons ... ..	353	6,297	0	17	50
	Broad, A. F. ... ..	605	9,524	0	15	45
		2,136	41,272	0	19	19

Gross Yield, 3 years—128,659 bus. 26 lbs.

Gross acreage, 3 years—6,819 acres.

Final average per acre over 3 years—20 bus. 22 lbs.

Moulinning, 1930	Cohen & Gibbs ... ..	230	5,458	9	23	44
	Clark Bros. ... ..	379	8,275	36	21	50
	Mott, H. ... ..	222	4,238	0	19	5
	Carwardine, F. ... ..	388	7,056	30	18	25
	Mott, C. ... ..	458	7,505	56	16	23
		1,672	32,534	11	19	28
1929	Wilson, A. F. ... ..	550	12,678	23	23	3
	Mott, C. ... ..	249	5,248	0	21	17
	Mott, H. ... ..	222	4,619	0	20	48
	Clark Bros. ... ..	315	6,014	54	19	6
	Hornsby & Sons ... ..	344	6,504	20	18	54
		1,680	35,064	37	20	52
1928	Wilson, A. F. ... ..	415	8,715	0	21	0
	Hornsby & Sons ... ..	250	5,184	0	20	32
	Clark Bros. ... ..	289	4,767	0	16	30
	Mott, C. ... ..	461	7,517	0	16	19
	Elder, A. ... ..	429	5,960	0	18	54
		1,844	32,093	0	17	24

Gross Yield, 3 years—99,691 bus. 48 lbs.

Gross acreage, 3 years—5,196 acres.

Final average per acre over 3 years—19 bus. 11 lbs.

District.	Members of Team.	Acreage.	Yield.			
			Gross.		Average per acre.	
			bus.	lbs.	bus.	lbs.
Tammin, 1930 ... ..	Nottage, R. B. ... ..	310	7,812	28	25	12
	Mann, J. W. ... ..	543	11,804	29	21	44
	Hocking, H. R. ... ..	395	8,506	49	21	32
	Uphill, G. ... ..	1,037	29,197	31	19	29
	Mackin, C. C. ... ..	855	15,154	44	17	43
		3,140	63,476	1	20	13
1929 ... ..	Nottage, R. B. ... ..	249	6,029	0	24	13
	Hocking, H. R. ... ..	392	8,011	25	20	31
	Mackin, C. C. ... ..	558	10,454	0	18	44
	Uphill, G. ... ..	902	16,157	25	17	55
	Mann, J. W. ... ..	609	10,755	0	17	40
		2,710	51,435	50	18	59
1928 ... ..	Uphill, G. ... ..	963	16,614	0	17	17
	Mann, J. W. ... ..	378	7,306	0	19	19
	Thomson, M. ... ..	621	9,984	0	16	6
	Mackin, C. C. ... ..	829	11,566	0	13	57
	Hocking, A. S. ... ..	385	5,718	0	14	51
		3,176	51,222	0	16	8
Gross Yield, 3 years 166,134 bus. 51 lbs.						
Gross acreage, 3 years—9,026 acres.						
Final average per acre over 3 years—18 bus. 21 lbs.						
Nungarin, 1930 ... ..	Williams, F. A. ... ..	337	9,126	50	27	5
	McDonnell & Hinkley ... ..	790	19,324	23	24	28
	Manuel, C. J. ... ..	248	6,043	5	24	22
	Waterhouse, H. H. ... ..	514	11,061	33	21	31
	Creagh, Bros. ... ..	1,172	22,392	45	19	37
		3,061	68,548	36	22	23
1929 ... ..	Johnston, J. H. ... ..	575	8,531	8	14	50
	Creagh Bros. ... ..	1,060	15,697	0	14	49
	Fitzpatrick, R. C. ... ..	753	11,200	18	14	18
	Dawe, S. D. ... ..	826	11,669	26	14	8
	Reynolds, A. G. ... ..	1,335	13,700	54	10	16
		4,579	60,799	16	13	17
1928 ... ..	Williams, F. A. ... ..	483	8,012	0	16	39
	Dawe, A. F. (Estate of) ... ..	290	4,738	0	16	20
	Creagh, Bros. ... ..	916	14,141	0	15	26
	Warner, F. L. ... ..	627	8,741	0	13	57
	Payne, H. G. ... ..	518	6,113	0	11	48
		2,834	41,775	0	14	44
Gross Yield, 3 years 170,922 bus. 52 lbs.						
Gross acreage, 3 years—10,474 acres.						
Final average per acre over 3 years—16 bus. 20 lbs.						

The shield, therefore, was won by the team nominated by the Gnowangerup District Agricultural Society, which averaged 26 bushels 6 lbs. for the three year period the competition was conducted. Their win was a well sustained effort, being placed second in the first year, first in the second year, and fourth in the final year, their average being 57 lbs. higher than the team which occupied second place, the Yandanooka team, and whose achievement was also a meritorious one.

During the course of the competition the total area harvested by all competitors was 92,498 acres for a total yield of 1,654,050 bushels, an average area yield of 17 bushels 53 lbs. Scattered, as they were, over widely separated portions of the wheat belt, the competitors have demonstrated that higher average yields per acre can be obtained when sound farming methods are adopted.

The keenness of those competitors, who, though realising that they had no chance of winning, still remained in the competition, is indeed very commendable.

## FRUIT FLY (*Ceratitis capitata*).

### A further series of Trapping or Luring experiments.

By

L. J. NEWMAN, Ento. F.E.S., and B. A. O'CONNOR, B.Sc., Agr,

In continuance of our efforts to discover improved methods of control of this very serious fruit pest, a series of Trapping or Luring Experiments have again been undertaken.

Many experiments along this line had previously been made, which demonstrated that the actions of insects are, to a large extent, directed by the sense of smell rather than that of sight. The sense of smell has been proved to be, for certain substances, remarkably acute. In an attempt to play upon this olfactory susceptibility we have continued our research. This is known as Chemotropism, which in common parlance means a reaction to stimuli of a chemical nature, perceived by the insect through its sense of smell. In the same manner it may be possible to discover some odour which will have a negative chemotropic reaction and thus act as a repellent.

Some of the chemicals tried proved to be absolutely neutral, the flies being neither attracted nor repelled. A fairly large number of weak attractants have been found, but few strong ones.

The discovery of the Pollard and Borax lure, evolved by us, was the first successful trapping medium that was recommended against this fly. This lure held its own until some 15 months ago, when we discovered that the proprietary spray known as "Clensel" gave better results.

In the Clensel we have a considerably more powerful lure. Just what is the particular constituent of this liquid soap that exerts this influence over the fly, has not been determined. It may not be due to any single factor but to a combination of attractive compounds. Having made this discovery, it was decided to test it out against the Pollard and Borax lure. The tests were carried out over a period of 12 months in a suburban garden. The first thing that had to be determined was the most effective and economical strength at which to use Clensel. It might be supposed that the stronger the concentration, the greater the catch of flies, but this is not so. There is a limit to the strength to be used, beyond that there is no advantage; in fact it was proved to be disadvantageous and rendered the treatment uneconomical.

Trials were commenced on the 28th May, 1930, and continued throughout the winter, spring and summer, to the 14th May, 1931. During these luring trials we also tested out the relative values of tins *versus* glass traps.

The lures used were Clensel at strengths of 1 in 20, 30, 40, 50, and 80 parts of water and the Departmental Pollard, Borax and water mixture. Ten tins, and ten glass jars of a capacity of half pint were used, making a total of 20 traps. These were half filled and placed, two of each type, making a total of four in each tree. The lures were renewed every seven days, and the total flies and their sexes in each trap recorded. In the following is given, in tabulated form, the results of the 12 months trials.

*Experiment commenced 28th May, 1930—Terminated 14th May, 1931.*

Lure.	Males.		Females.		Total.
	No.	%	No.	%	No.
Clensel ... ..	4,883	29·8	11,514	70·2	16,397
Pollard and Borax ...	1,066	26·3	2,990	73·7	4,056
					20,453

A perusal of this table reveals that the Clensel lure captured 16,397 fruit flies, or roughly four times as many as the Pollard and Borax. Further, it will be seen that the percentage of females is only slightly less than the Pollard and Borax.

Table 2.—TIN *versus* JAR.

—	Males.		Females.		Total.
	No.	%	No.	%	No.
Tin ... ..	3,636	30·5	8,286	69·5	11,922
Jar ... ..	2,313	26·3	6,218	72·9	8,531
					20,453

The results brought about by this test show, taking the year through, that the tin traps yielded some 3,391 more flies than the glass ones. This lead was gained during the height of the fly season (February to April) when luring is less effective as a means of control. It was noted, however, that during the months of July to October the glass traps gave practically as good results. As this is the most important trapping period, we would recommend the use of glass jars in preference to tins for the following reasons:—They do not rust or lose their brightness; they last a lifetime unless broken; glass jars are more readily kept clean than tins; the flies captured can be readily seen by the operators and thus they are stimulated to continue the operation of the traps.

TABLE 3.

In this table is given the monthly capture, percentage of sexes, aggregate percentage of males and females, and total captured in the combined lures.

Month.				Males.		Females.		Total.
				No.	%	No.	%	No.
June ... ..				306	15·3	1,693	84·7	1,999
July ... ..				14	12·8	95	87·2	109
August ... ..				6	30·0	14	70·0	20
September ... ..				7	20·6	27	79·4	34
October ... ..				7	41·2	10	58·8	17
November ... ..				13	41·9	18	58·1	31
December ... ..				57	29·4	137	70·6	194
January ... ..				396	53·2	349	46·8	745
February ... ..				39	47·6	43	52·4	82
March ... ..				1,370	28·7	3,396	71·3	4,766
April ... ..				2,987	29·8	7,018	70·2	10,005
15th May ... ..				747	30·5	1,704	69·5	2,451
Total ... ..				5,949	29·1	14,504	70·9	20,453
Total males ... ..				No.		Aggregate		%
				5,949				29·1
Total females ... ..				14,504		do. ... ..		70·9
Total ... ..				20,453				



By a study of this table the rapid falling away in the number of flies captured after the month of June is shown. It is not until late November that any great increase in capture is again noted. This has been proved each year that tests of this nature have been made and goes to substantiate our oft-repeated declarations, that this fly is mainly, if not solely, carried over the months of July to November, per medium of over-wintering females.

These flies are attracted to the citrus trees which offer good shelter from the rain, wind and cold. The flies feed upon honey dew given off by Scales and Aphides, juice of split citrus fruits, etc. It is always important in dealing with an insect pest to determine how and where it spends the winter, because it can often be fought more efficiently during this season than during the period of its summer activity. There is definite evidence that the fruit fly, provided it can obtain the necessary shelter and food supply, can withstand considerable periods of cold and wet. We have failed to find any native fruits suited to the propagation of this fly, hence the trouble is confined to our orchards. This renders the control considerably easier than in those countries where suitable native fruits exist outside the orchards.

#### SUMMARY.

(Lensel at a strength of 1 part to 30 parts of water is recommended as the luring agent. It attracts both sexes of the fruit fly. Renew lure every seven days in summer or whenever traps go dry. Renew in cool weather every 10 to 12 days.

Glass jars as traps are advised, especially during the months of July to December.

The most effective time to lure is between July and December. One female fly captured during this period is worth thousands caught during the peak of the season.

If fruit is present on trees, hang traps in proximity to same.

Hang traps in sunny aspect from April to October. During summer, hang in shady position.

The minimum number of traps per tree is two. As many more may be used as the operator can attend to.

The trapping or luring method is advised for small orchards up to 200 trees. In larger orchards they may be used as indicators of the presence of the fly, when the foliage bait should be at once applied once a week.

Trapping appeals to most people (this is particularly so when glass jars are used) because it gives great satisfaction to the operator in that he or she is able to see the capture.

The most vulnerable period to attack this fly is between the months of July to December. Unfortunately, most growers take little or no interest in the pest until it again appears in plague form.

In view of the known facts concerning the fruit fly in this State, it behoves all growers, large or small, to continue the warfare throughout the whole year, whenever weather conditions will permit. The reduction brought about by the destruction of the winter and spring flies is most important in any control of this pest.

The captures may be few, but it must be remembered that these are the progenitors of the myriads which appear in the mid and late summer.

Once again it must be repeated that orchard sanitation must be strictly practised, which means the keeping clean of all litter and rubbish, and the daily picking up and boiling of infested fruits.

## CHEMICAL WEED KILLERS.

### PRELIMINARY REPORT ON THE USE OF CALCIUM AND SODIUM CHLORATES AS WEED KILLERS.

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G. R. W. MEADLY, B.Sc., Agricultural Adviser.

During recent years chlorates have come under notice as weed killers, and various experiments have been carried out in different parts of the world in order to ascertain the best strengths to use and methods to employ in weed eradication. One of the first trials in America demonstrated that Johnson Grass can be successfully controlled by the application of a 10 per cent. solution of sodium chlorate in spring, followed by a further spray in summer, to kill any plants which may have survived the first application.

#### EXPERIMENTS CARRIED OUT BY THE DEPARTMENT.

1. *Commercial calcium chlorate*.—On 20th January small areas in the experimental plot at Perth were sprayed with 5 per cent., 10 per cent., and 15 per cent. solutions of commercial calcium chlorate, using a fine spray, and applying until the foliage of the plants was completely covered. The main plants present were:—

*Anagallis* spp. (Pimpernel).  
*Chenopodium ambrosioides* (Ant Weed).  
*Cynodon dactylon* (Couch Grass).  
*Cyperus* spp. (Nut Grass, etc.).  
*Digitaria marginata* (Summer Grass).  
*Echinochloa colona* (Barnyard Millet).  
*Medicago denticulata* (Burr Trefoil).  
*Melilotus indica* (King Island Melilot).  
*Nasturtium officinale* (Water Cress).  
*Paspalum dilatatum* (Paspalum).  
*Plantago major* (Rib Grass).  
*Polygonum aviculare* (Wire Weed).  
*Polypogon monspeliensis* (Beard Grass).  
*Portulaca oleracea* (Purslane).  
*Ricinus communis* (Castor Oil).  
*Rumex* spp. (Docks).  
*Solanum nigrum* (Nightshade).  
*Sonchus oleracea* (Milk Thistle).  
*Stellaria media* (Chickweed).  
*Villarsia* spp. (Wild Violet).

Although at the end of the first day after spraying several plants, particularly Nightshade and Docks, were showing decided signs of wilting, with the exception of the 15 per cent. portion the majority of the plants recovered. The 5 per cent. was of little or no use; the 10 per cent. produced a drying effect, killing a few of the less hardy plants, whereas the 15 per cent. apparently destroyed a number of plants, the young Nut Grass in particular being affected.

Further experiments were carried out with 15 per cent. solution on Blackberries at Jarrahdale. Although at the end of the first week the leaves were considerably shrivelled, the plants soon recovered and produced normal shoots.

From the results obtained it is evident that commercial calcium chlorate is not particularly satisfactory as a weed killer, for even when using a 15 per cent. solution the results obtained were not impressive.

2. *Commercial sodium chlorate*.—A corresponding series of experiments was carried out using varying concentrations of sodium chlorate. On the experimental plot it was found that a 5 per cent. solution, in general, was sufficient to kill the Castor Oil plants. With this strength some of the Nightshade recovered, but with 10 per cent. and 15 per cent. solutions the Nightshade, Nut Grass, and majority of other weeds were apparently killed. The 15 per cent. produced more marked results than the 10 per cent. and a greater drying effect was noted.

Five per cent., 10 per cent., and 15 per cent. solutions were used in spraying Blackberries at Jarrahdale. The 15 per cent. solution was first used (5th February) and in a fortnight all the leaves were dried and the branches were also wilting back considerably. Five weeks after application a very limited number of green leaves were evident (12th March), and the plants were then burned.

Three weeks after spraying with 5 per cent. and 10 per cent. solutions the plants were wilted back, apparently to the same extent as with the stronger solution, and no new shoots were evident. This effectiveness of the weaker solutions may be due to the slower wilting produced in the leaves and consequently the increased opportunity to take in more of the solution before plasmolysis occurs.

As far as can be ascertained at this stage of the experiments, sodium chlorate should be a very effective spray for eradicating most weeds, since at present it appears that two of our most persistent weeds, Nut Grass and Blackberry, may be controlled by means of it.

#### PROPOSED EXPERIMENTS.

1. Blackberry (*Rubus fruticosus*). Further experiments will be carried out on this during the coming season.
2. Cape Tulip (*Homeria collina* and *H. miniata*).
3. Guildford Grass (*Romulea rosea*).
4. Geraldton Carnation Weed (*Euphorbia terracina*).
5. Cape Thistle (*Berkheya carduoides*).

Trials will be conducted with various concentrations of sodium chlorate at suitable times.

#### METHOD OF APPLICATION.

It has been demonstrated elsewhere that sodium and calcium chlorates can be used in solution or in the crystal form. It is much more economical to apply these salts in solution, since the quantity of material use by this method is only about one-sixth of that used in the dry state.

#### TIME OF APPLICATION.

It is generally accepted that the most suitable time to apply the sprays is when the plants are in full bloom, the application being made in the sunlight. In contrast with most other weed killers, chlorates do not usually show immediate results—branches gradually dying back and finally the whole plant succumbing.

Spraying or treatment should never be attempted in the winter, and cultivation prior to application of chlorates is not recommended if best results are required.

The effectiveness of the treatment increases as the plants approach maturity. This may be attributed to the fibrous nature of the plants as they near maturity, and the ease of dissemination of the chemical through the rooting system.

Treatments are considered more effective if the water table is more or less stationary or slightly lowering at the time of application.

### STRENGTH OF SOLUTION.

The strength of the solution varies with the type of weed and the stage of growth when applied. A 10 per cent. solution (1 lb. crystal to 1 gallon water) is generally recommended, but some of the softer types of weeds may be destroyed by a 2½ per cent. solution. About 100 gallons of the spray per acre have been found sufficient in most cases. When applying crystals instead of spraying, approximately 640 lbs. per acre are required.

### SPRAYING APPARATUS.

For general use the knapsack sprayer is the most serviceable. This should be fitted with a trigger spray to prevent waste. The nozzle should be very fine so as to enable the whole leaf surface to be covered without undue waste.

### CAUTION.

The apparatus in which sodium chlorate has been used must be thoroughly cleaned by rinsing several times in clean water. Clothing, straw, or chaff moistened with the solution and permitted to dry may be ignited by friction or a spark. The material should be handled very carefully, and the solution should not be prepared in barns or sheds.

### POISONOUS PROPERTIES.

In America it has been shown that sodium, magnesium and calcium chlorates are non-poisonous to man, farm animals or the soil. In New Zealand it is stated that both sodium and calcium chlorate are safe as far as stock are concerned and spraying may be done while the paddocks are being grazed. During the spraying of Blackberries at Jarrahdale, cattle were grazing in the same paddocks and experienced no ill effects.

### DANGEROUS PROPERTIES.

As chlorates are easily inflammable when dry, users are advised to thoroughly wash clothing that may become saturated with the solution during spraying operations. Sodium chlorate, while quite safe to handle by itself, forms explosive mixtures with a number of other substances such as strong acids, sulphur and sugar. Always use alone either in the crystal form or in solution.

Our thanks are due to Messrs. Cuming Smith-Mt. Lyell Farmers' Fertilisers, Ltd., and to Messrs. F. H. Faulding and Co., Ltd., for supplying materials used.

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## PRODUCERS' MARKETS REPORT.

Producers' Markets Co-operative Limited Report for the three months ended 15th May, 1931:—

*Fruit.*—Supplies during the period came forward freely, and all prime varieties sold to a good demand. New Season Apples forward in February realised good values, and have since increased in volume and sold at fair values until April. At this point, large consignments of Rejects and Culls came forward to make it impossible to realise fair values; at the same time all prime coloured 2½in. and 2¾in. realised satisfactory values. Oranges: Valencias were forward in volume early and the market was very unsettled until early in March the demand increased and values improved and remained selling at satisfactory prices for f.a.q. to prime.

New Season Navels came forward on 1st April, and were sold to a fair demand. The majority were not matured and played a big part in retarding values, and towards the end of this period they came forward in volume and values eased considerably. **Pears:** Only a moderate supply, forward early; the bulk of the Bartlett's were marketed in March, and the demand was unsettled throughout for f.a.q. to prime, always in demand. Other varieties: the crops were light, the only prime were in demand. Lemons were forward in volume throughout, with fair values being maintained. Early Peaches were forward in fair consignments, and eased at the end of March; fair values were maintained throughout. Plums: good supplies forward in February, and values were firm for all prime large varieties. The President always held pride of place, realising up to 23s. 6d. Prime Nectarines, large and coloured, realised good prices to 17s. 3d. for three-quarter bushel. A good quantity of small and large green forward, which only met a medium demand. Early in February Grapes were forward in volume, with supplies about the same as the period of 1930, and values were in favour of 1931. In February Passion Fruit were well supplied and were sold to a good demand, realising (best) 5s. to 11s. 6d. for three-quarter bushel cases, and easing in volume as from 8th March; values firmed and remained firm. Tomatoes were heavily supplied in February, March and April, with a demand for prime. 1931 supplies were above 1930, and with values in favour of the latter. Good supplies of Figs were forward in three-quarter bushel cases and realised very satisfactory values throughout.

*Vegetables.*—Supplies during the period have been heavy. Most gardeners report 100 per cent. crops of all lines, pests of all kinds causing very little destruction. Potatoes from the metropolitan area were heavily supplied and values were much below the average, although they were better than last season's return. Country lines have been moderately supplied to a fair demand for prime lines. The new regulations regarding marketing are now in operation, and growers are conforming to them, with very few exceptions. Pumpkin supplies were heavy, and values consistently low; inferior samples hard to quit. Swedes have been short supplied all through the period, and the demand firm; values being high for all prime lines. Cabbage supplies were heavy, and values lower than is usual during this period; country lines were hard to quit at satisfactory rates. Cauliflowers were forward in small quantities early in the quarter, and values were then firm; as supplies increased values receded a little; supplies are now equal to demand and values are firm. Peas have also had a heavy crop, and supplies plentiful; values have maintained a steady level. Beans have been glutted practically all the time and prices below the paying level. Brown Onions maintained a steady value, imported lines affecting the market towards the end of the season. White Onions sold well, high prices being paid for prime lines during the last month. Rock Melons were plentiful to a steady demand for prime varieties, "Rocky Fords" and "Best of All" being the lines principally sought. "Honey Dew" were plentiful this season, but values were not equal to the other varieties mentioned. Cucumbers were plentiful to a good demand, while weather conditions were favourable. Celery has been heavily supplied during the period and values considerably easier than previous seasons; the crop was a bumper one, and the demand easier than usual, being the principal factor in easy values for this line. Rhubarb supplies have been heavy, and values maintained a steady level; bunch lines heavily supplied to a steady demand for most lines, Beetroot being an exception. Lettuce heavily supplied to a weak demand; all lines below prime at glut level; a few prime lines touched fancy prices, but these were rare cases.

*Eggs.*—During February heavy supplies of eggs were sold to a steady demand, prices ranging from 1s. to 1s. 2d. per dozen for metropolitan new laid hen eggs. This price remained unaltered until the second week in March, when diminishing sup-

plies caused a steady rise in the price which continued until the 1st April, when prices ranged from 1s. 9d. to 1s. 10½d. per dozen. The following week heavier forwardings caused the market to reede, and on the 8th April prices were 1s. 5d.\* to 1s. 6½d. The increase of supplies was only of a temporary nature, and with the advent of colder weather prices took another sharp rise, which continued until the end of April, when prices ranged from 2s. 3d. to 2s. 6d. per dozen. The effect of these prices on the demand was reflected the following week, when the market dropped to 1s. 10d. to 2s. per dozen, with demand very weak. Since then the demand has been fairly steady at these rates.

*Poultry.*—During the quarter under review fairly heavy supplies of all lines were marketed to a moderate demand. Prices throughout have shown a decline on the same period last year, in sympathy with practically all lines of produce. During the latter half of February fairly heavy supplies came forward to a steady demand and prime lines realised: Cockerels, 6s. 6d. to 8s. 6d.; Hens, 6s. to 8s.; Muscovy Drakes, 6s. 6d. to 8s. 3d. Turkeys were short supplied, and quality poor. Good prime lines met with a keen demand. March brought an increase in supplies, the demand being steady, and values showed little alteration. Heavy supplies were maintained during April, and the demand also improved. Prices were: Cockerels, 8s. to 10s.; Hens, 6s. to 8s.; Muscovy Drakes, 7s. to 9s. Very few good quality turkeys were offered. Supplies during May have been short, but as the demand has been weak, practically no alteration in price has taken place.

*Carcass Meat.*—Pork and veal were lightly supplied during February and March, and to a good steady demand. Beef supplies were moderate. Lamb and Mutton were heavily supplied, and values steady. April opened with light supplies of all lines offering, with prime Lamb and Mutton in keen demand, but medium quality was hard to quit. Little alteration in values was noticed during the latter part of the month, with the exception that Beef supplies shortened and values improved. At present only medium supplies of Pork and Veal are coming forward to a steady demand. Beef, Lamb and Mutton are well supplied.

*Latest Prices.*—Prime Pork, 6d. to 6½d.; Medium Pork, 5d. to 5½d.; Veal: prime Calves, 6d. to 6½d.; Medium Calves, 5d. to 5¾d.; Lamb, 4½d. to 5¾d.; Mutton, 4d. to 4¾d.

## MARKET REPORT.

Messrs. H. J. Wigmore & Co., Ltd., of Wellington Street, Perth, have supplied us with the following information regarding Chaff available for auction at the Metropolitan Chaff and Grain Auction Sales, held in Perth, for the period March to May (inclusive). In all cases the price quoted is for f.a.q. to prime Wheaten Chaff, packed in new bags:—

—				Quantity.	Maximum.	Minimum.
				tons.	£ s. d.	£ s. d.
March	...	...	...	925	3 15 0	3 12 6
April	...	...	...	920	3 17 6	3 10 0
May	...	...	...	795	4 5 0	4 0 0

In March and April the market was about on a par with the preceding three months, but it will be noticed that in May prices were rather better. This can be accounted for firstly, by the rather better demand; secondly, by the falling off in

supplies of f.a.q. to prime, farmers having this quality preferring to hold in anticipation of better values. The dry spell experienced in May also had the effect of tightening the market somewhat, but even now that beneficial rains have fallen we do not anticipate any marked decrease in the prices of best quality. Upon going to press the market is firm, f.a.q. to prime being worth from £4 5s. to £4 7s. 6d. per ton, f.a.q. from £3 17s. 6d. to £4 per ton, other qualities lower.

*Oaten Chaff*.—The same remarks as to Wheaten Chaff apply. The value of prime quality at time of going to press is from £3 15s. to £3 17s. 6d., f.a.q. £3 12s. 6d. per ton.

*Oats*.—In March the market was lifeless, good heavy feeds selling at from 1s. 5d. to 1s. 6d. per bushel; April showed some improvement, 1s. 9d. to 2s. 1d. per bushel being obtainable for best quality. The market in May was steady at April rates, and at time of going to press the market is firm at from 1s. 11d. to 2s. per bushel for good heavy feeds.

*Wheat*.—The market, in sympathy with overseas values, has fluctuated somewhat, at time of writing there being a firm demand at auction for f.a.q. at from 2s. 7½d. to 2s. 8d. per bushel.

Farmers holding surplus seed can be assured of a ready market at the Perth auctions for either truck loads or small parcels.

## LIVE STOCK AND MEAT.

For the information of readers of this "Journal," the following particulars have been supplied by Messrs. Elder, Smith, and Coy., Ltd., Perth.

COMPARATIVE FIGURES OF STOCK SOLD AT METROPOLITAN FAT STOCK MARKETS,  
FOR MONTHS OF MARCH, APRIL AND MAY, 1931.

	March.				April.					May.			
	4th.	11th.	18th.	25th.	1st.	8th.	15th.	22nd.	29th.	6th.	13th.	20th.	27th.
Sheep ...	10,770	9,742	9,903	10,018	9,415	9,959	10,661	9,951	8,811	7,122	9,753	8,731	12,014
Cattle ...	518	583	624	685	530	534	650	529	567	620	565	767	627
Pigs ...	1,000	1,393	1,393	1,409	1,730	1,207	1,468	1,221	1,177	919	1,116	1,004	1,255

COMPARATIVE VALUES PER POUND.

	March.				April.					May.			
	4th.	11th.	18th.	25th.	1st.	8th.	15th.	22nd.	29th.	6th.	13th.	20th.	27th.
	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
Mutton ...	3	3	3	3½	3½	3½	4	4	4½	5½	5½	6½	5½
Beef ...	6½	5½	5½	5	4½	4½	4	4½	4	3½	3½	3	4½
Pork ...	6½	6½	6½	6½	6½	6½	6½	6½	6½	7	7	7½	7½
Bacon ...	5½	5½	5½	5½	5½	5½	5	5½	5½	5½	5½	5½	5½

## METEOROLOGICAL INFORMATION.

STATIONS.	TEMPERATURE.				RAINFALL.	
	Maximum.	Minimum.	Mean.	Highest.	For Month.	Aver. age.
MARCH, 1930.						
Chapman State Farm	91.2	101.6	62.6	54.7	0.12	0.65
Geraldton	85.6	103.8	63.4	54.2	0.07	0.45
Walebing	88.5	101.0	59.2	50.8	0.17	0.76
Perth	83.5	98.6	62.0	55.1	0.90	0.77
Kalamunda	82.7	95.6	60.0	50.1	0.83	0.85
Bunbury	77.9	88.0	56.4	47.2	0.78	1.00
Bridgetown	85.4	101.0	48.9	36.8	0.78	1.05
Albany	72.9	88.0	58.1	48.0	1.08	1.55
Meredin State Farm	86.3	97.2	59.0	47.2	0.04	1.09
Norham	88.0	99.0	59.6	51.0	0.20	0.74
York	87.1	97.0	57.9	48.0	0.14	0.64
Narrogin State Farm	82.7	94.0	53.9	41.6	0.54	0.81
Katanning	81.3	94.2	55.1	45.0	1.24	0.95
Cape Leeuwin	73.0	84.5	61.5	54.5	0.23	1.25
APRIL, 1931.						
	inches.		95.5	48.2	inches.	
	0.12		81.5	57.5	0.61	0.44
	0.07		78.8	50.8	0.29	0.82
	0.17		78.5	53.4	1.39	0.79
	0.90		74.4	37.5	3.96	1.64
	0.83		73.0	42.3	3.60	1.89
	0.85		73.4	41.6	1.93	1.71
	1.00		72.3	55.2	2.29	1.71
	0.78		74.6	41.0	4.02	2.76
	0.78		74.6	48.3	1.91	0.78
	1.08		69.3	34.4	0.91	0.80
	0.04		87.0	43.8	0.73	0.81
	0.74		86.4	40.0	1.94	0.15
	0.20		93.6	53.4	1.28	0.13
	0.14		76.9	41.0	4.36	2.19
	0.64		92.0	52.1		
	0.81		92.2	49.0		
	0.54		86.8	36.4		
	1.24		73.6	37.1		
	0.95		72.5	51.7		
	1.25		69.3	49.4		
MAY, 1931.						
	inches.		68.9	49.5	inches.	
	0.61		70.2	41.3	0.44	0.32
	0.29		65.1	53.5	0.82	0.79
	1.39		65.7	43.4	3.96	36.4
	3.96		63.7	40.0	1.64	40.0
	3.60		63.1	41.8	1.89	41.8
	1.93		64.5	37.0	1.71	37.0
	2.29		63.0	28.8	2.76	28.8
	4.02		61.8	39.8	1.91	39.8
	1.91		61.8	31.9	0.78	31.9
	0.91		65.8	44.3	0.80	44.3
	0.73		65.3	34.0	0.81	34.0
	1.94		61.3	31.5	1.28	31.5
	1.28		60.9	33.0	4.36	33.0
	4.36		62.6	45.8		
			67.8	53.4		



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## LIST OF BULLETINS AVAILABLE FOR DISTRIBUTION.

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 No. 20.—*The Pruning of Fruit Trees*. J. F. Moody. Price 2s. 6d.  
 No. 24.—*Hints to Stock Breeders* (revised). R. E. Weir.  
 No. 30.—*Descriptive Account of the Codlin Moth*. L. J. Newman.  
 No. 37.—*Conference of Producers, 1910 and 1912*.  
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 No. 114.—*Blue Mould on Citrus Fruits*. W. M. Carne.  
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- No. 290.—*Wax Scale (Ceroplastes Ceriferus)*, Anderson. L. J. Newman, F.E.S., Entomologist; B. A. O'Connor, B.Sc., Agr., Agricultural Adviser; and H. G. Andrewartha, B.Sc.Agr., Agricultural Adviser.
- No. 291.—*"Early Blight" or "Leaf Spot" and the Macrosporium "Storage Disease" of Potatoes*. H. A. Pittman, B.Sc.Agr., Plant Pathologist.
- No. 292.—*Cultivation of Onions*. E. T. Morgan, Vegetable Inspector.

The following publications may be obtained from the Department of Agriculture, Perth, on application, or will be sent post free to any address in this State on receipt of a remittance for the amount stated:—

*The Handbook of Horticulture and Viticulture of Western Australia*, by A. Despiessis, M.R.A.C.:

This publication contains valuable information dealing with all commercial fruits grown in Western Australia, including advice on planting, pruning, packing, manuring, fruit-drying, wine-making, insect and fungoid pests and their treatment, etc., and the whole forms a text book which every fruitgrower, whether large or small, should have in his possession. The price originally was 8s. 6d., but to allow of distribution being as wide as possible it has been reduced to 2s.

*The Pruning of Fruit Trees*, by J. F. Moody, Fruit Industries Commissioner:

This publication contains numerous illustrations, being reproduction of photographs taken in this State, of pruned and unpruned trees, which make the details set out in the letterpress particularly easy to understand. Price 2s. 6d.

*Fruit Packing and the Marketing and Exporting of Fruit*, by J. F. Moody, Fruit Industries Commissioner, and J. Ramage, Packing Instructor:

This publication contains invaluable information on packing and grading fruit for local and export markets. It is freely illustrated, and no fruit-packing shed should be without a copy. Price 1s. 6d.

# JOURNAL

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## Department of Agriculture

OF

### WESTERN AUSTRALIA.

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No. 3.

#### THE PROBLEM OF OUR SURPLUS SHEEP.\*

GEO. L. SUTTON, Director of Agriculture.

#### THE INCIDENCE OF THE PROBLEM.

After providing for total local consumption requirements, and allowing for losses due to deaths and other causes, our annual sheep surplus now amounts in round figures to 820,000. This position is the result of commendable enterprise on the part of our pastoralists and agriculturists, but in achieving it the relative proportion of sheep in the agricultural and pastoral districts has been entirely altered. Because of this, and accentuated by the collapse of the wool market, the matter demands serious and urgent attention lest the reward of enterprise turn to "Dead Sea Fruit."

TABLE 1.  
SHEEP IN AGRICULTURAL AND PASTORAL AREAS OF W.A.  
1900-1930.

Year.	Agricultural Areas.*		Pastoral Areas.		Total for W.A.	
	Number of Sheep.	Increase + or Decrease. —	Number of Sheep.	Increase + or Decrease. —	Number of Sheep.	Increase + or Decrease. —
1900	602,074	...	1,742,237	...	2,434,311	...
1901	763,053	+ 70,979	1,862,802	+ 120,565	2,625,855	+ 191,544
1902	775,494	+ 12,441	1,929,386	+ 66,584	2,704,880	+ 79,025
1903	845,284	+ 69,790	1,755,349	— 174,037	2,600,633	— 104,247
1904	1,022,414	+ 177,130	1,831,010	+ 75,661	2,853,424	+ 252,791
1905	1,226,990	+ 204,576	1,893,713	+ 62,703	3,120,703	+ 267,279
1906	1,386,799	+ 159,809	1,953,946	+ 60,233	3,340,745	+ 220,042
1907	1,657,874	+ 271,075	2,027,100	+ 73,154	3,684,974	+ 344,229
1908	1,867,346	+ 209,472	2,229,978	+ 202,878	4,097,324	+ 412,350
1909	2,040,692	+ 173,346	2,691,045	+ 461,067	4,731,737	+ 634,413
1910	2,243,452	+ 202,760	2,915,064	+ 224,019	5,158,516	+ 426,779
1911	2,453,484	+ 210,032	2,958,058	+ 42,994	5,411,542	+ 253,026
1912	2,230,020	— 223,464	2,366,938	— 571,120	4,596,958	— 814,584
1913	2,120,313	— 109,717	2,301,062	— 65,876	4,421,375	— 175,583
1914	2,076,894	— 43,419	2,379,292	+ 78,230	4,456,186	+ 34,811
1915	2,181,077	— 104,183	2,622,773	+ 243,481	4,803,850	+ 347,664
1916	2,480,704	+ 299,687	3,040,196	+ 426,423	5,529,960	+ 726,110
1917	3,023,920	+ 543,156	3,360,271	+ 311,075	6,384,171	+ 854,231
1918	3,622,574	+ 598,654	3,561,173	+ 200,902	7,183,747	+ 799,566
1919	3,633,956	+ 11,382	3,063,995	— 497,178	6,697,951	— 485,796
1920	3,625,797	— 8,159	2,907,168	— 156,827	6,532,965	— 164,986
1921	3,501,032	— 124,765	3,005,145	+ 97,977	6,506,177	— 26,788
1922	3,261,298	— 239,734	3,402,837	+ 397,692	6,664,135	+ 157,958
1923	3,161,505	— 99,793	3,434,362	+ 31,525	6,595,867	— 68,268
1924	3,517,964	+ 356,459	2,878,600	— 555,762	6,396,564	— 179,303
1925	3,916,755	+ 398,791	2,945,045	+ 66,445	6,861,795	+ 465,231
1926	4,246,325	+ 329,570	3,212,441	+ 267,396	7,458,766	+ 596,971
1927	4,777,257	+ 530,932	3,670,223	+ 457,782	8,447,480	+ 988,714
1928	4,828,546	+ 51,289	4,114,456	+ 444,233	8,943,002	+ 495,522
1929	4,795,323	— 33,223	4,761,500	+ 647,044	9,556,823	+ 613,821
1930	*4,899,497	+ 104,174	*4,971,503	+ 210,003	*9,871,000	+ 314,177

† South-West Division.

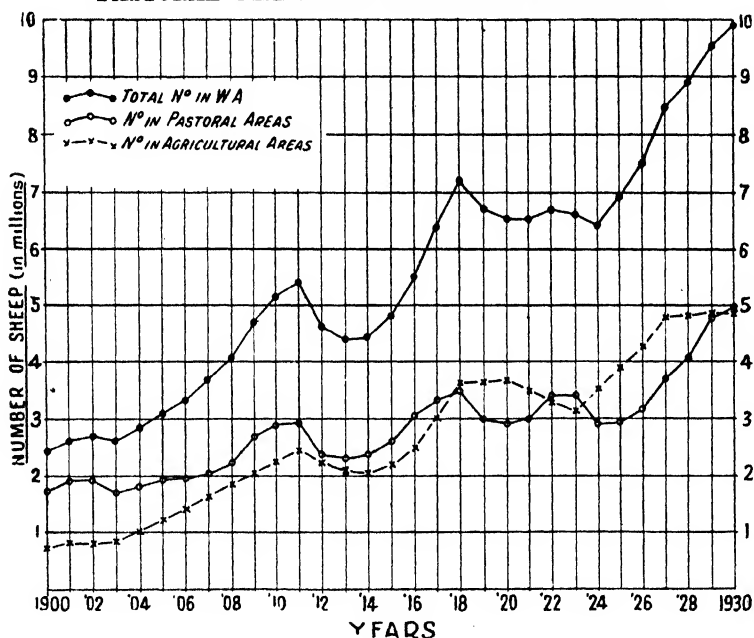
\* Preliminary figures.

\* A Paper read before the W.A. Branch of the Economic Society of Australia and New Zealand on 31st July, 1931.

From Table 1 it will be seen that at the end of the last century there were 2½ times as many sheep in the pastoral areas as in the agricultural areas, the respective numbers being 1,742,237 and 692,074. In both areas the numbers continued to increase, but to a greater extent in the agricultural areas, for in 1918 the numbers of sheep in the agricultural and pastoral areas were approximately equal. Since then the development in each area has been along parallel lines, so that the relative positions have been maintained with similar aggregate increases until at the end of last year (1930) the total number of sheep in the State was approximately ten millions, with equal numbers in the pastoral and agricultural areas. It will thus be seen that in thirty years the sheep population has increased four times, that in the pastoral areas 2·8 times and in the agricultural areas seven times. The present relative positions and the changes that have taken place are graphically shown in Diagram A; from this it will be seen that during

DIAGRAM "A."

GRAPH SHOWING SHEEP IN AGRICULTURAL AND PASTORAL AREAS OF WESTERN AUSTRALIA.



the thirty years there have been three periods during which there have been rapid and unbroken increases in the numbers of the State flock. The first break in the continued progress occurred in 1911 and was due to unfavourable seasonal conditions in both areas. With a recovery from these the upward move recommenced and continued until the apex of the second period was reached in 1918, when the State sheep were approximately equally divided between the agricultural and pastoral areas. It is evident that temporary saturation had been reached, and that a similar position to that which now obtains had developed then. Further, there were indications that the time had passed when the extending development was keeping pace with the increasing surplus.

Those with an outlook broad enough to visualise the position established at Fremantle the works of the W.A. Meat Exports Co. With the establishment

of these works it was reasonable to expect that, under normal conditions, an expanding export within reasonable limits would cope with the decreasing capacity for development. That the time was ripe for the erection of these works was proved by the export, on their completion in 1922, of 25,456 lambs and of 13,115 in 1923. A buoyant wool market, and the discovery of the suitability of the East Murchison and Eastern Goldfields country for sheep, brought about an unforeseen condition of affairs, and the absorption of our surplus sheep by increased development. This provided an unexpected outlet for the surplus sheep and stopped the export.

Unsatisfactory as have been the results of the enterprise to the promoters of the W.A. Meat Exports Co., it is fortunate for the State at this time that these facilities exist.

TABLE II.

## YEARLY ADDITIONS AND DEDUCTIONS OF SHEEP IN W.A.

1901-1929.

Year.	Number of Sheep in State.	Lambs marked.	Imports (live.)	Internal consump- tion.	Deaths.	Exports.	Annual State increase.
	thousands.	thousands.	thousands.	thousands.	thousands.	thousands.	thousands.
1901 ...	2,628	580	74	425	75	3	192
1902 ...	2,705	540	66	453	135	4	70
1903 ...	2,601	530	90	412	138	...	104
1904 ...	2,853	700	50	499	123	2	253
1905 ...	3,121	790	38	466	103	2	267
1906 ...	3,341	740	86	468	147	2	220
1907 ...	3,685	962	97	465	153	...	344
1908 ...	4,097	1,082	90	423	196	...	412
1909 ...	4,732	1,226	41	457	212	1	634
1910 ...	5,159	1,357	30	550	200	7	427
1911 ...	5,412	1,240	38	623	334	15	253
1912 ...	4,597	795	38	610	829	23	815
1913 ...	4,421	994	35	629	431	27	176
1914 ...	4,456	1,046	26	586	404	11	35
1915 ...	4,804	1,300	22	565	252	9	348
1916 ...	5,530	1,547	10	547	261	6	726
1917 ...	6,384	1,709	6	590	282	3	854
1918 ...	7,184	1,839	5	630	345	12	800
1919 ...	6,698	1,353	3	800	604	23	486
1920 ...	6,533	1,513	5	840	618	18	165
1921 ...	6,506	1,601	7	856	506	16	27
1922 ...	6,664	1,565	19	900	510	50	158
1923 ...	6,596	1,467	8	809	559	35	68
1924 ...	6,397	1,264	11	586	887	20	199
1925 ...	6,862	1,640	41	614	629	4	465
1926 ...	7,459	1,805	55	713	466	18	597
1927 ...	8,447	2,184	63	784	462	30	989
1928 ...	8,943	2,069	35	807	809	34	496
1929 ...	9,557	2,261	41	882	590	28	614
Averages...	5,461	1,300	39	620	388	14	246
Percentages	% 100	% 24	% 0.7	% 11	% 7	% 0.3	% 4.5

Table II. has been compiled from the records published by the Government Statistician, Mr. S. Bennett, with the object of obtaining average figures relating to natural increase and consumption requirements, deaths, etc., by ascertaining the different yearly additions to, and deductions from the State flock, the balance between which would be the increase or decrease for the year. It was found that this balance did not agree with the yearly increase or decrease in the sheep numbers. In most years the decreases were apparently under-estimated, but over the whole period the discrepancy amounted to less than  $1\frac{1}{2}$  per cent.—a negligible amount. In view of the "extensive" methods which necessarily obtain in Western Australia, where "stragglers" etc., have to be estimated, such a close reconciliation of figures must be regarded as very satisfactory and a tribute to the methods of the Statistical Department.

From this Table it is learnt that the number of lambs marked amounts to 24 per cent. of the total sheep, and that the importations are comparatively small, amounting to 39,000 annually, or 0.7 per cent. There has been a decided increase in the consumption requirements, naturally in sympathy with the increase in our population. The deaths and other losses account for 7 per cent. There has been comparatively little export, and, though this has increased slightly in later years, it has averaged only 14,000 per year, or slightly more than a third of the average number imported. With scanty export it is obvious that the ever increasing surplus has been absorbed in our own State as the result of the greater development of older pastoral areas, the utilisation of new pastoral country on our Eastern Murchison and Eastern Goldfields country, and the adoption of sheep farming as an ally of wheat growing in the Wheat Belt as the pioneer holdings became developed sufficiently to carry sheep.

The increasing number of our natural increase each year brought the State nearer and nearer to the inevitable time when, despite development stimulated to the maximum, it would be impossible to absorb the whole. It is believed that that time is due or almost due, but, whether this belief is well founded or not, it has certainly arrived now as the result of the collapse of the wool market.

The collapse of the wool market has effectually prevented any additional development for wool on either old or new holdings in the pastoral areas, and in the agricultural districts, even where financial resources are not exhausted, any additional increase in the number of Merino sheep carried must be restricted to the absolute minimum necessary for the economical working of the farm.

A corollary to the cessation of development has been a serious disturbance of industrial conditions which has added tremendously to the unemployment difficulties, consequent upon the general financial stress existing throughout the Commonwealth.

The agriculturist can comparatively quickly adapt himself to the altered conditions by changing the character of his husbandry. The pastoralist, however, because of his geographical location, and the climatic conditions under which he works, cannot do so, and hence he will be the greater sufferer.

In the past the surplus in the pastoral areas has been disposed of—

- (1) by exporting several thousands to British Malaya ;
- (2) by supplying part of the needs of the Metropolitan markets, and
- (3) by supplying the sheep necessary for the increased development, both in the pastoral and agricultural areas.

The market in British Malaya still remains.

The requirements of the Metropolitan mutton market have increased in sympathy with the increase in population. The latest returns show that the number of persons in the State as at 31st December, 1931, was 422,346 made up as follow :—

In pastoral areas	....	....	....	....	18,880
In agricultural areas	....	....	....	....	194,615
In metropolitan areas	....	....	....	....	208,851
<hr/>					
Total	....	....	....	....	422,346

TABLE III.  
CONSUMPTION OF MUTTON IN W.A.

PER HEAD OF POPULATION.

Year.	Population.	Carcases consumed.	Carcases per head.	Year.	Population.	Carcases consumed.	Carcases per head.
1901	194,109	428,234	2.21	1916	308,806	547,041	1.77
1902	213,327	482,877	2.27	1917	309,423	589,557	1.91
1903	226,954	412,484	1.81	1918	313,447	629,593	2.01
1904	242,289	499,331	2.06	1919	331,060	799,971	2.41
1905	254,779	466,002	1.83	1920	331,323	839,885	2.54
1906	261,746	468,418	1.79	1921	335,715	856,239	2.55
1907	263,846	465,114	1.77	1922	343,608	899,974	2.62
1908	270,823	423,056	1.56	1923	353,815	899,340	2.29
1909	276,743	457,098	1.65	1924	364,124	887,446	2.44
1910	276,832	549,977	1.99	1925	372,183	613,899	1.65
1911	286,584	622,555	2.17	1926	378,746	712,589	1.88
1912	301,362	619,214	2.03	1927	392,292	784,256	2.00
1913	320,684	619,075	1.93	1928	405,873	807,337	1.99
1914	324,195	585,528	1.81	1929	216,763	861,717	2.07
1915	318,016	564,535	1.78	1930	422,346	Not available.	

1901-20 Average consumption per head = 2.03 carcasses.

= 93lb. weight.

Average weight Australian export carcass -

1927/28 = 44lb.; 1928/29 = 50lb.; 1929/30 = 44lb.

Average weight = 46lb.

From Table III. it will be seen that the rate per capita has remained fairly constant around about two carcasses (av. 46lb.) per year. When compared with the rate of other countries this is extremely high, and it cannot be expected to increase. \*The annual per capita consumption of mutton and lamb elsewhere is—United Kingdom, 26lb.; Canada, 6lb., and the United States of America, 5½lb. Though our population has more than doubled, the natural increase of our sheep has been at a considerably greater ratio, and is sufficient to provide for the requirements of over 3½ times the increased population.

Through the courtesy of the Chief Traffic Manager, W.A.G.R., it has been ascertained that the number of sheep transported over the railways to the Mid-land markets from the agricultural areas in 1930 was 539,813, and that from the pastoral areas, i.e., from stations East of Mullewa and Southern Cross, was 59,310. In addition the Chief Inspector of Stock (Mr. A. L. McKenzie-Clark) advises that 66,337 were received by sea from North-West ports, making a total of 125,647. Using this number as being the share of the pastoral areas to meet the Metropolitan market requirements it will be seen from Table IV. that there are 654,000 surplus sheep in the pastoral areas, and, if the balance of the Metropolitan market requirements be supplied by the agricultural areas, the surplus in those areas will be 167,000, and in the State it will be 821,000. It is realised that some sheep are overlanded by road from the pastoral to the agricultural areas, and therefore, the figures used relatively for the pastoral and agricultural contributions to the Metropolitan requirements are not strictly correct; it is impossible, however, to ascertain what they really are and whatever they may be they will not alter the number of the State surplus.

\* Commonwealth Year Book, 1930.



TABLE IV.  
OUR SURPLUS SHEEP.

	Pastoral areas. (thousands.)	Agricultural areas. (thousands.)
Number of sheep ... ..	5,000	5,000
Lambs marked = 24 per cent.	1,200	1,200
Consumption in area (2 per head) ... ..	38	390
Balance ... ..	1,162	810
Deaths ... ..	350	350
	812	460
Export of Live Sheep ... ..	33	...
	779	460
To Metropolitan Markets by sea and rail ... ..	125	...
	654	460
Balance of Metropolitan Mar- kets requirements ... ..	...	293
	654	167
	821	
Total Surplus =	821,000	

The pastoral areas will always supply some of the demand of the Metropolitan market for mutton, but now, with the increased numbers of sheep in the agricultural areas, and unless some new outlet can be found for their surplus, these areas will of necessity severely contest the right of the pastoral areas for that share of the Metropolitan market requirements which they have had in the past. In competition for this local market the advantage is likely to be with the agricultural areas because of lower freights, and, with an insufficient outlet for their surpluses, the competition must inevitably become so keen as to lower the prices below the costs of production with disastrous results to both pastoral and agricultural areas alike.

This development of an industry for which our State was admirably adapted, and was in great need, has been deliberately achieved as the result of a bold Governmental policy. It is recognised that the rate at which it has taken place has been a worthy achievement by our pastoralists and agriculturists, but the inability to dispose of the surplus sheep adds immensely to the almost impossible economic position of both the pastoralist and the agriculturist, consequent upon the collapse in wool values. As the State's prosperity is bound up with that of the sheep industry it is imperative to search for an outlet for the surplus sheep, and, as there is now no local one, the possibility of their export in some form demands consideration.

#### PROSPECTS OF THE EXPORT TRADE.

The Eastern States of Australia are much in the same position as Western Australia, and, in consequence, can provide no outlet for our surplus sheep; on the contrary, if local prices increased sufficiently above their export parity to more than cover the costs of transport, sheep from the Eastern States would invade our local market.

For several years this State has exported live sheep to British Malaya. Table V., compiled from the Australian Statistics of Oversea Imports and Exports, shows

the number exported each year for the past five years, and from this table it will be seen that this market is practically the only one to which live sheep are exported; the largest number exported in any one year was during the past year when 33,205 were sent away. Though this market is a limited one yet, because it affords an outlet for North-West sheep, it requires to be fostered to the maximum extent, and search made for others of a similar character.

## EXPORTS OF LIVE SHEEP FROM W.A.

TABLE V.

Year.	To Malaya (British.)	Total.
1925-26 ... ..	18,872	18,936
1926-27 ... ..	30,403	30,403
1927-28 ... ..	30,717	30,717
1928-29 ... ..	28,102	28,154
1929-30 ... ..	33,205	33,205
Grand Totals ... ..	141,299	141,415

From the figures in Table V. it is obvious that the export market for live sheep is extremely limited, and that the bulk of our surplus will require to be exported, if at all, in carcase form. Table VI., compiled from the same source as Table V., shows the principal countries to which Australian mutton has been exported during the past five years. From this table it will be seen that the principal market by far is that of the United Kingdom to which 82 per cent. of the exported mutton was sent in 1929-30. In this connection the Commonwealth Chief Veterinary Officer (Mr. R. P. Allen) advises: "The exports of mutton to Gibraltar, Malta and Egypt relate almost totally to the Mediterranean War Office contracts. The War Office does not buy lamb for these stations. Germany has closed her doors to the importation of frozen meat of all kinds, and France has a trade agreement with South America which is more favourable to that country than to Australia."

TABLE VI.

## PRINCIPAL IMPORTING COUNTRIES OF AUSTRALIAN MUTTON.

(IN CENTALS.)

Country.	25/26.	26/27.	27/28.	28/29.	29/30.
United Kingdom ... ..	232,650	301,057	103,211	314,766	282,616
Canada ... ..	2,757	2,985	2,736	9,041	7,145
Ceylon ... ..	2,859	3,248	2,839	2,994	3,072
Hong Kong ... ..	4,228	3,134	3,353	2,727	1,918
Malaya ... ..	5,795	4,624	5,755	5,487	6,677
Gibraltar ... ..	1,716	338	1,282	2,177	1,121
Hawaii ... ..	597	212	152	348	243
Philippines ... ..	577	670	528	779	460
United States ... ..	...	231	379	5,391	1,144
Malta ... ..	7,071	6,428	5,022	7,407	5,213
Belgium ... ..	...	...	4,784	6,731	20,925
Egypt ... ..	5,175	2,700	2,411	3,546	2,772
France ... ..	3,429	5,147	4,734	1,640	5,755
Germany ... ..	...	...	932	489	5,781

The relative volume of trade to the United Kingdom of Australia and her competitors, mainly New Zealand, Argentina and other South American countries from 1909 to 1930 may be seen from Table VII. The relation of the Australian

TABLE VII.  
MUTTON IMPORTED INTO GREAT BRITAIN.  
1909-1930.

Year.	Mutton exported from—			Total including small quantities from other sources.
	Australia.	New Zealand.	Argentina and other South American countries.	
				carcases.
1909 ... ..	1,327,141	1,869,599	2,718,665	5,915,455
1910 ... ..	2,723,148	1,991,115	2,838,714	7,552,977
1911 ... ..	1,962,048	1,795,259	3,058,943	6,816,250
1912 ... ..	1,643,790	2,315,453	2,717,363	6,676,606
1913 ... ..	2,983,751	2,249,705	2,143,998	7,377,454
1914 ... ..	2,088,222	2,616,650	2,041,929	6,746,801
1915 ... ..	2,179,952	2,830,233	1,450,526	6,463,368
1916 ... ..	270,959	2,410,126	1,453,767	4,192,298
1917 ... ..	602,119	1,525,883	1,078,743	3,221,483
1918 ... ..	23,506	1,188,787	1,230,127	2,442,804
1919 ... ..	1,670,316	2,996,036	1,755,147	6,426,181
1920 ... ..	3,035,650	4,043,006	1,563,214	8,650,209
1921 ... ..	260,625	5,374,088	2,960,001	8,596,863
1922 ... ..	910,003	2,983,619	2,137,608	6,031,230
1923 ... ..	1,609,143	1,724,730	2,894,455	6,228,328
1924 ... ..	212,228	1,984,165	2,746,216	5,077,698
1925 ... ..	252,318	2,192,016	2,773,717	5,380,358
1926 ... ..	489,526	2,393,370	2,657,887	5,605,290
1927 ... ..	624,706	2,227,125	2,496,467	5,374,598
1928 ... ..	566,324	2,100,174	2,407,663	5,077,084
1929 ... ..	353,010	1,753,546	2,104,058	4,210,614
1930 ... ..	726,519	2,557,326	1,904,604	5,188,449

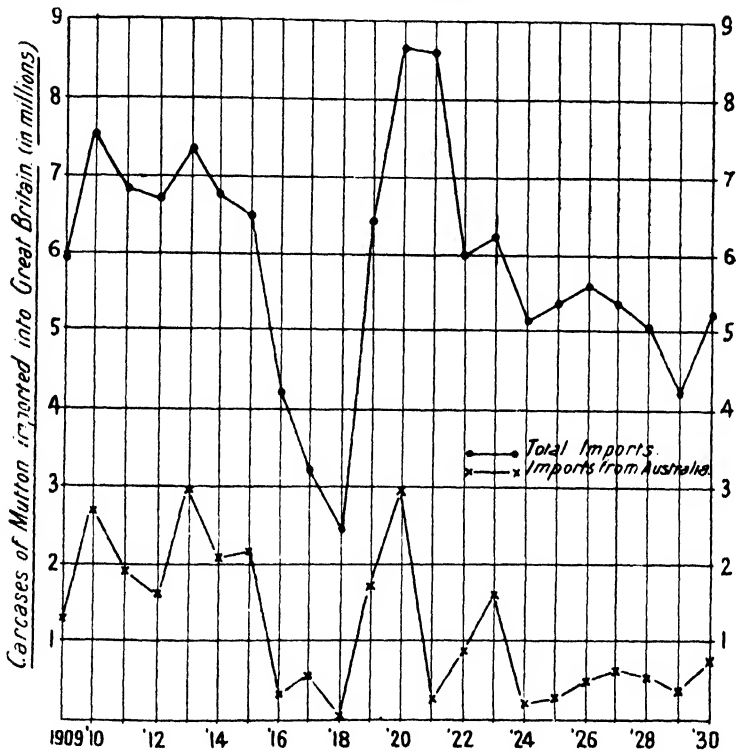
exports to the total exports is graphically shown in Diagram B, and from this it will be seen that the variations in the respective curves are remarkably sympathetic. Because of the varying geographical location of these countries it is unlikely that this sympathy is due to similar seasonal variations in each country. It is more than probable that it is due to prices ruling in the different years. Color is given to this opinion by the fact that the price for frozen mutton sometimes is so low as to be little, if anything, above the cost of treatment and transport. This was the case last year during the months of May, June, July and August, when the price obtained for Australian mutton varied from 3½d to 3¼d. per lb., and only during the first three months of the year did it exceed 5d. Messrs. Colebatch & Scott (Roseworthy Agricultural College) during an investigation into certain aspects of Fat Lamb Production on agricultural holdings estimated the expenses incurred in exporting lambs from Roseworthy College to London at 3d per. lb. Using this figure as representing the cost of treating and transporting mutton from Australia to the United Kingdom it will be seen that an export trade in mutton is only possible when comparatively high prices rule. Competition from South America is likely to be keener in this market than formerly, for, as advised by Mr. Allen "most of the mutton and lamb exported from South America in 1926, 1927, 1928.

1929 and 1930 went to Germany and France. Last year, however, Germany prohibited imports of frozen meat, and the bulk now goes to France, who, by the way, have a trade treaty with South American countries in which the import duty on meat is all in favour of South America as compared with Australia."

DIAGRAM "B."

**GRAPH SHOWING MUTTON IMPORTED INTO U.K.,  
1909-1930 :**

**TOTAL AND AUSTRALIAN.**



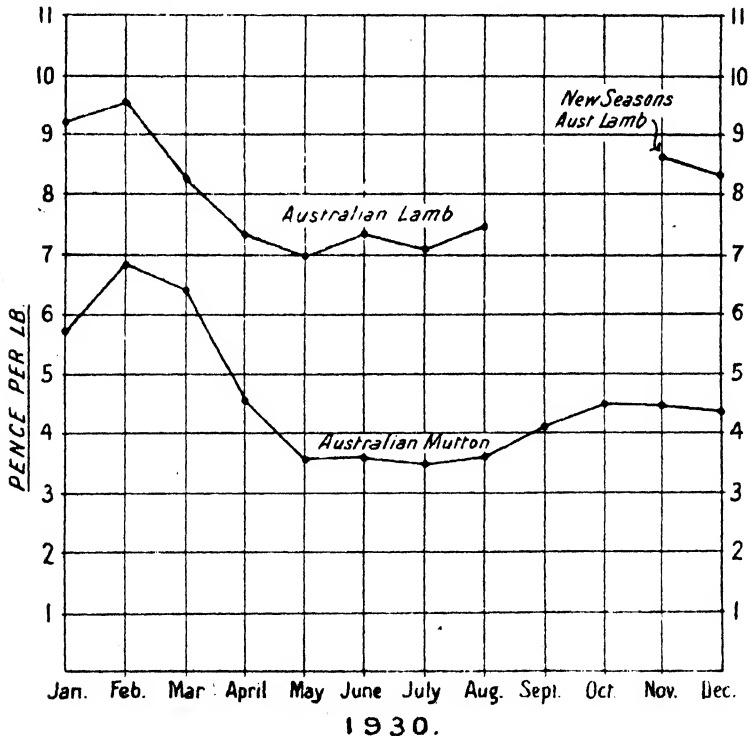
The outlook for frozen mutton is not promising, it is further complicated by the fact that the British market is closed to carcasses of sheep which have been affected with caseous lymphadenitis. This trouble affects the lymphatic glands, and, where the gland is affected it is removed, and such carcasses rejected for export to the United Kingdom. I am again indebted to the Chief Veterinary Officer, Commonwealth Department of Markets, for the information that in New South Wales and Victoria rejections for this cause have averaged about 35 per cent. in sheep three years old and upwards, and up to 20 per cent. in two-year old sheep and about 2 per cent. in lambs. Sufficient mutton has not been treated for export at the Fremantle Works to enable an definite idea as to the extent of the affection in this State. Even if it were much lower than in the Eastern States the disposal of the balance would still remain a serious problem.

It has been suggested that an outlet for some of our surplus mutton, and particularly the rejects, would be as canned meat. Mr. Allen, however, points out: "The possibilities of increased trade in this direction appear to be remote. The overseas demand has been found to be extremely limited. In fact it is likely that even five thousand cases dumped on the London market would dislocate the present trade. Whatever demand there is for canned meats appears to be confined to corned beef and this product is already slow of sale."

Fortunately, the outlook for the export of lamb is decidedly better. Diagram C has been prepared from data published by Messrs. Geo. Keen and Co., London, and from this it will be seen that the price of frozen lamb throughout the year is more than 3d per lb greater than that of mutton, i.e., the extra price is more than sufficient to pay the cost of treatment and transport.

DIAGRAM "C."

**GRAPH SHOWING MONTHLY PRICES OF AUSTRALIAN LAMB AND MUTTON RULING AT SMITHFIELD—1930.**



In Table VIII. will be found the principal countries to which Australian lamb has been exported. Quoting Mr. Allen again: "America appeared to have possibilities, and in 1929 New Zealand exported fairly large quantities of lamb to America. In 1930, however, the United States of America imposed a duty of 5 cents per lb. on imported mutton and 7 cents per lb. on imported lamb, and this effectively stopped further importations of these classes of meat. Subsequently, a little business was done with Canada."

TABLE VIII.  
PRINCIPAL IMPORTING COUNTRIES OF AUSTRALIAN LAMB.  
(IN CENTALS.)

Country.	25/26.	26/27.	27/28.	28/29.	29/30.
United Kingdom ... ..	573,192	579,510	301,285	431,360	601,578
Canada ... ..	2,693	9,315	6,154	27,270	32,808
Ceylon ... ..	1,253	1,436	1,440	1,719	2,418
Hong Kong ... ..	1,785	1,260	1,460	1,869	1,577
Malaya ... ..	4,146	5,713	5,731	9,585	6,818
Gibraltar ... ..	...	...	...	...	...
Hawaii ... ..	3,566	3,696	4,846	4,811	4,715
Philippines ... ..	963	684	1,134	1,308	1,159
United States ... ..	...	67	14	4,923	2,452
Malta ... ..	...	...	...	...	...
Belgium ... ..	...	...	...	...	2,288
Egypt ... ..	1,003	688	1,191	861	1,056
France ... ..	...	...	...	...	...
Germany ... ..	...	...	...	...	...

Ninety-two per cent. of the total Australian lamb exports were sent to the United Kingdom in 1929-30. Here again, as with mutton, the British market is the only one of any magnitude available for the Western Australian portion of the Australian surplus. The steadily increasing exports to this market from the competitors of Australia for this trade are shown in Table IX., and prove conclusively how valuable this market is regarded by them. Last year it was so abundantly supplied that its anticipated requirements were exceeded. In this connection Mr. Allen writes: "The greatest quantity of lamb that could be consumed in the United Kingdom is estimated at about twelve million carcasses, and of mutton about five and a-half million carcasses. Considering these figures were exceeded in 1930 if is a matter of wonderment where the surplus goes to."

TABLE IX.  
Lambs Imported into Great Britain, 1909-1930.

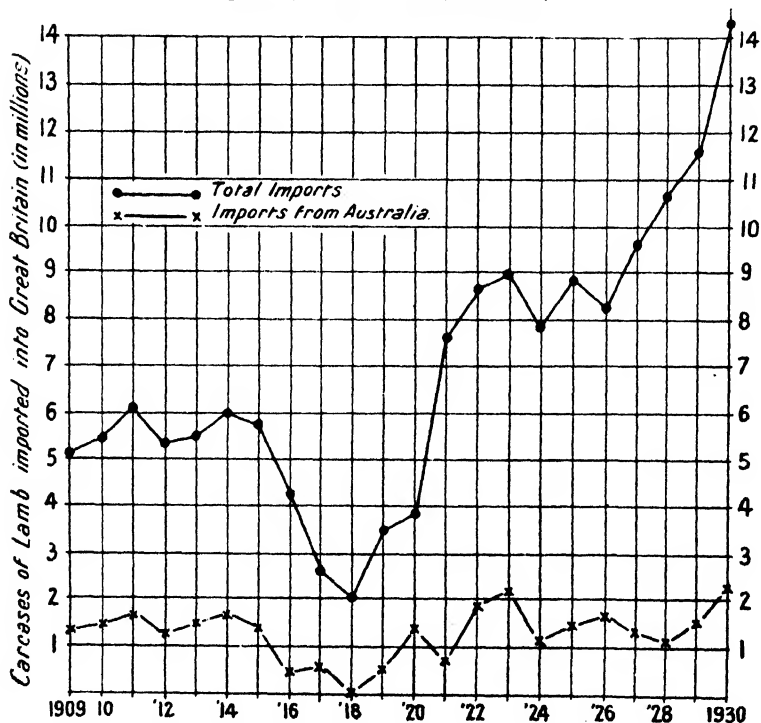
Year.	Lambs exported from—			Total, including small quantities from other sources.
	Australia.	New Zealand.	Argentina and other South American countries.	
1909 ... ..	1,351,697	3,165,504	634,496	5,151,697
1910 ... ..	1,496,660	3,416,359	515,048	5,428,067
1911 ... ..	1,650,231	3,427,236	1,066,666	6,144,133
1912 ... ..	1,239,689	3,179,838	913,032	5,332,559
1913 ... ..	1,458,766	3,423,919	676,026	5,558,711
1914 ... ..	1,634,608	3,564,534	842,896	6,142,038
1915 ... ..	1,402,959	3,663,964	661,070	5,727,993
1916 ... ..	400,929	2,997,096	857,684	4,280,438
1917 ... ..	594,021	1,347,995	670,007	2,616,512
1918 ... ..	15,072	1,641,925	370,980	2,028,052
1919 ... ..	484,497	2,633,389	364,308	3,482,219
1920 ... ..	1,441,224	1,927,663	468,008	3,836,920
1921 ... ..	719,693	4,942,157	1,914,261	7,582,907
1922 ... ..	1,843,049	4,792,452	1,958,668	8,594,169
1923 ... ..	2,125,736	4,490,017	2,291,004	8,907,557
1924 ... ..	1,180,860	4,624,564	2,079,908	7,904,385
1925 ... ..	1,447,411	4,480,627	2,827,922	8,790,429
1926 ... ..	1,679,995	4,721,045	1,866,801	2,280,841
1927 ... ..	1,325,108	5,085,322	3,172,565	9,611,170
1928 ... ..	1,176,090	5,782,565	3,697,867	10,655,682
1929 ... ..	1,494,515	5,741,582	4,379,883	11,625,980
1930 ... ..	2,220,582	7,146,146	4,911,670	14,278,398

From Diagram D, in which Australian lamb exports to the United Kingdom are compared with the total exports, it will be seen that, though there has been a slight increase in the Australian exports during the last three years, the total number exported from Australia last year was little greater than the exports seven years ago. It is obvious that Australia has not been utilising the advantages of the British market to the some extent as her competitors. Now, however, that Australia must seek some outlet for the surplus sheep this market must be exploited to the utmost.

DIAGRAM "D."

GRAPH SHOWING LAMB IMPORTS INTO U.K.,  
1909-1930 :

TOTAL AND AUSTRALIAN.



It is disconcerting to find this market so abundantly supplied, but as it is our only market it is imperative that, whilst the prices are at all remunerative, its proper share be secured by Western Australia. In order to capture our share of this trade, fierce competition will require to be faced, and, to successfully overcome this, it will be necessary to study very carefully its requirements, and cater for them an almost meticulous extent.

#### THE PROBABLE UTILISATION OF THE EXPORT POSSIBILITIES.

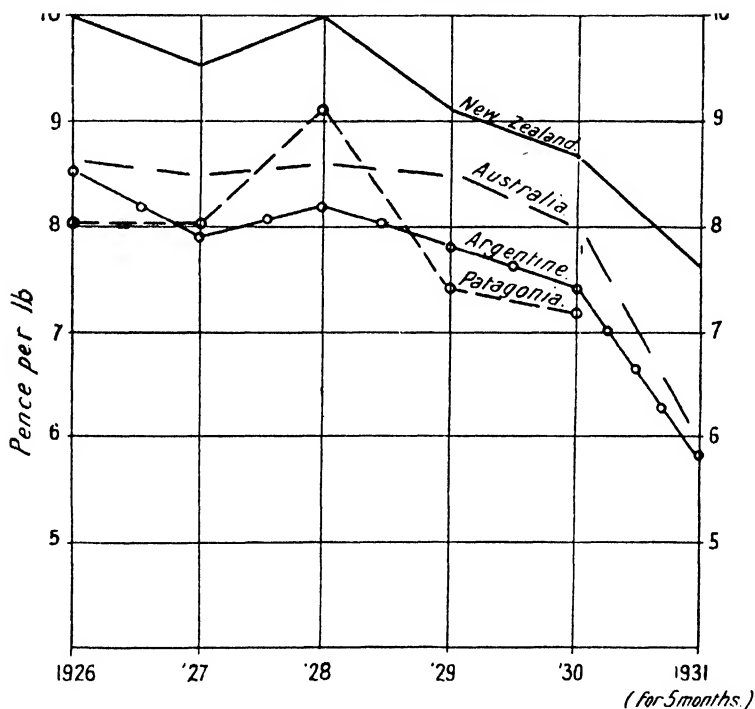
Only lambs which conform to the best features of the Southdown breed are in keen demand on the British market. Juicy and tender as Australians may have found the Merino lamb, particularly when eaten where it is produced, it is totally unsuited for the requirements of the British market, whose customers have become accustomed to sheep especially bred and selected for the excellence of their

meat. The Merino, on the other hand, has been developed, and marvellously developed, as a wool-producing animal and neither its shape, which is too angular nor the colour of its meat, which is too dark, meet the requirements of the British market.

In its present form there is thus NO MARKET for our surplus sheep either as mutton or lamb. Its character must be changed for there is a market, though at present well-supplied, for lamb of a certain type in the United Kingdom. Consideration must, therefore, be given to a change in our practice so as to produce the type of lamb required by this market.

DIAGRAM "E."

GRAPH SHOWING AVERAGE FROZEN LAMB PRICES  
AT SMITHFIELD MARKETS.



Unsuitable as may be the Merino lamb for the market of the United Kingdom, the Merino ewe, because it is the predominant West Australian type, must of necessity be the basis from which the suitable export lamb will be evolved. Fortunately, experience has proved that, by mating the Merino ewe with one or other of the more suitable British breeds, a great improvement in carcase qualities has resulted. As an example of this the production of the famous New Zealand "Canterbury" lamb may be cited. As pointed out by Dr. Nicholls, this lamb is produced by mating the Merino ewe with the English Leicester ram, and producing what is technically known as a Longwool-Merino crossbred. Experience at "Newmarra-carra," "Cranmore Park," the Merredin and Chapman Experiment Farms, and elsewhere has shown that this cross is quite at home in parts of Western Australia. Probably, however, the related Border Leicester, similar in type, but of great robustness, will prove even more suitable for the major portion of our

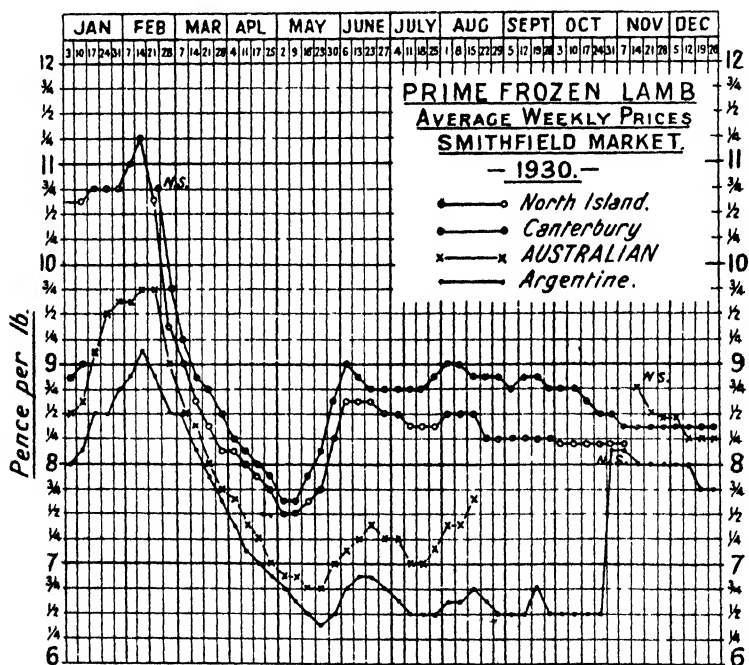


agricultural areas. Neither cross, however, is as suitable for other than the agricultural and more favoured pastoral areas as the Merino.

Diagram E shews the average prices which have ruled at Smithfield market for frozen lamb from 1926 to date. From this it will be seen that the New Zealand lamb has held pride of place during the whole of the period, and that Australian lamb, though bringing about 1½d. per lb., less than the New Zealand, has held second place, except in 1928 when, for some reason which is not at present apparent, the price for Patagonian lambs exceeded that for Australian ones.

New Zealand lambs may be divided into two main classes, those coming respectively from the North and South Islands, the latter being given the distinctive name of "Canterbury" lambs, and which have earned a special reputation. Diagram F, compiled by Geo. C. Keen & Co., Ltd., shows the weekly prices during 1930 obtained by the different types of lamb, as indicated by their country of origin. From this it will be seen that, except on two occasions, the prices ruling for New Zealand "Canterbury" lamb were greater than those for either New Zealand North Island or Australian lamb.

DIAGRAM "F."



"Canterbury" lambs have held, and in a general way still hold, pride of place regarding quality and price in the lamb market of the United Kingdom. Within the past two or three years, however, the proud position of the "Canterbury" lamb has been contested, and successfully contested, in a few instances, by a further cross, i.e., that by mating the Longwool-Merino ewe with the South-down ram. One instance of this was reported last season (1930) by the Veterinary Officer stationed at Smithfield markets. *Inter alia* he writes in December, 1930: "There were three main shows of New Zealand lambs, consisting of prize lambs from the Royal New Zealand, Manawatu and Waikato shows. Nothing during

the month, or the year, for that matter, exceeded the display of Messrs. W. Weddell and Company of Salisbury lambs from the Waikato A. & P. Show. Keen judges with thirty years' experience were unanimous in pressing the opinion that nothing finer than the prize-winning lambs has ever been seen at Smithfield. As they consisted mainly of Southdown-Romney Marsh crossbreds, it is probable that nothing finer will be seen, and particularly as there was a delightful bloom on the carcasses, the absence of which during recent times has given rise to so much concern."

The same Officer with regard to some Victorian lambs bred on similar lines wrote in September, 1930: "The 'Yarrowonga' Down Cross lambs which have been so favourably received always, have invariably made  $\frac{1}{2}$ d. per lb. more than the best New Zealand and  $1\frac{1}{2}$ d. or more over C.A.Q. Australian, and, moreover, they have established for themselves such a good name that they can be disposed of in advance of their arrival at this margin."

The "Yarrowonga" lambs so favourably referred to were, like the North Island New Zealand lambs, sired by Southdown rams, but it is understood the mothers were Border Leicester-Merino ewes. Both the Border Leicester and Romney Marsh breeds belong to what is known as the Longwool group of British breeds. The Romney Marsh, because of its very great and inherent resistance to foot rot, is specially adapted to districts where wet conditions and consequent risk of foot rot obtains. The Border Leicester, because of its hardiness and virility, is more adapted to drier conditions.

Here, then, is indisputable evidence that the supremacy of the famous New Zealand "Canterbury" lamb has been successfully assailed by a better type of lamb—the progeny of the Southdown sire and Longwool-Merino crossbred ewe. When they are critically examined, and due allowance is made for the special climatic conditions, and consequent requirements of the districts in which they were produced, the breeding methods followed are the same, and the guiding principle which should govern the breeding of West Australian export lambs is seen. In both cases the Southdown sires belonged to a distinct group of the British sheep, viz., the Downs group, the principal members of which known to W.A. farmers are the Southdown, Shropshire and Dorset Horn. Similarly, the mothers were the progeny of Merino ewes mated with rams belonging to another group of British sheep, viz., the Longwool group, to which belong the Leicester, Border Leicester, Lincoln and Romney Marsh, each of which is more suited than the others for a special environment, and all of which have been found to be very suitable for mating with the Merino, and when so mated produce progeny of similar characteristics.

The superiority of the Southdown cross lambs is again referred to in the report of the Veterinary Officer, London, for the month of October, 1930, when he wrote: "During the years I have been in London, in round figures Australia and New Zealand have shipped to the United Kingdom 4,000,000 and 17,000,000 lambs respectively. Some 4,000,000 of the New Zealand lambs have been "Down Cross," and they have brought roughly 2d. per lb. more than the 4,000,000 Australian lambs. The remaining 13,000,000 have brought 1d. or more per lb. more than the 4,000,000 Australians with the exception that a few Australian Southdown cross lambs have brought  $\frac{1}{2}$ d. per lb. above the highest price obtainable for New Zealand lambs available at the same time."

The "few Australian Southdown cross lambs" referred to are undoubtedly the "Yarrowonga" Down cross lambs of the September report. That they should enjoy a superiority over New Zealand lambs of the same breeding and type is due to the better colour of the Australian lamb. This is brought out in the report of the Veterinary Officer, London, for January, 1931, in which it is stated, "As I have suggested before if there is one point of vantage which the Australian

lamb enjoys it is in regard to colour, and I am advised that with an Australian and a New Zealand lamb of equally good conformation and finish the preference should be usually awarded to the Australian."

The pre-eminent position of the "Yarrowonga" Southdown crossbred lamb on the market of the United Kingdom is of particular interest to Western Australia, for Yarrowonga is an agricultural district situated in the North-West part of Victoria on the Murray, about mid-way between Dookie and Deniliquin, with conditions very similar in character to those which obtain in the Avon Valley and Moora districts. What can be done in a district like this can be done equally as well in Western Australia, provided the same methods are adopted. The experience of Mr. S. B. Rudduck, of "Koobabbie," Coorow, and of Mr. W. G. Burges, of "Tipperary," York, and others with the Southdown-Longwool Merino crossbred is definite evidence that this type can be produced in Western Australia.

The practical inferences to be drawn from these facts are that the British buyer desires, and is prepared to pay the best price for Southdown crossbred lambs and that Western Australia should produce this type wherever possible, for this West Australian lamb, in common with other Australian lambs, will also secure the premium merited by its better colour.

The correct type or conformation will be secured only by breeding, and this is the first essential for success in connection with the production of export lambs, but as with dairy cattle, a second and equally important one is FEED. Export lambs require to be marketed as suckers from 12 to 16 weeks' old, and to provide the "bloom" and finish necessary to meet successfully the strong competition at Smithfield, ample feed is essential from the time the lamb is dropped until it is sent to market as a "sucker." The New Zealand farmer finds it necessary to supplement the excellent natural pastures with specially grown fodder crops, like rape and turnips. He regards export lamb raising as a specialist's business and makes provision for ample supplies of the necessary feed. The West Australian farmer must do likewise and grow those fodder crops—oats, rape, peas, turnips, etc.—for which his district is best adapted. At first sight Western Australia would appear to be at a disadvantage with New Zealand in this connection, because of its shorter growing period, but, when it is realised that the growing season required by the export lamb is only 12 to 16 weeks it seems likely that this State with its Mediterranean climate and quick winter growth, has an advantage over New Zealand in this respect.

From Diagram F it will be seen that on two occasions during 1930 the price of "Canterbury" lambs did not, as is usual, exceed that of the other brands. The first period was from the second week in January to the second week in February; the second period was from the second week in November to the first week in December. On both occasions the loss of the premier position was due to the fact that new season's, i.e., fresh lambs, of both types, were preferred to the end of season, or lambs that had been in store for some time. This indicates that in this abundantly-supplied market there is an advantage in having new season's lambs, when those of our competitors are comparatively stale, and as early as possible in the Australian season.

Because of its geographical position Western Australia has two advantages over the Eastern States producers, and they are—

- (1) The season is earlier, and
- (2) The period of transport from loading port to market is shorter.

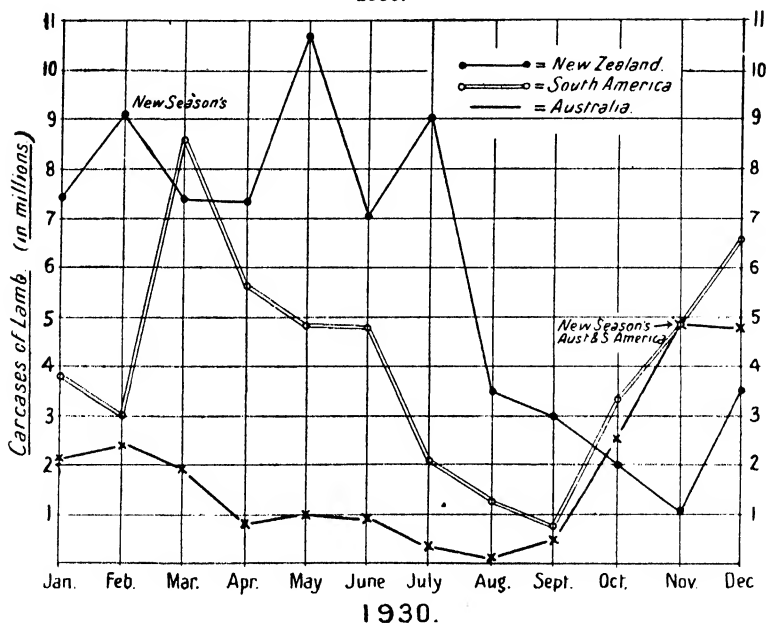
Because of these factors West Australian lambs should be the first of the Australian lambs on the London market. How great is this advantage is shown by the following statement by the Chief Veterinary Officer (R. P. Allen): "The

best prices in the United Kingdom for Australian lamb are always obtained for new arrivals, say, September. The earlier the lamb arrives in the United Kingdom the better the price."

From Diagram G, it will be seen that the lamb imports from the principal importing countries to the United Kingdom are at their lowest during the months of August and September, whilst the supplies arriving are not great until November. Because of the early season Western Australia should be able to take full advantage of this, and land its lambs so as to escape the keener competition which must obtain when full supplies are coming forward.

DIAGRAM "G."

**GRAPH SHOWING LAMB IMPORTS INTO GREAT BRITAIN,  
1930.**

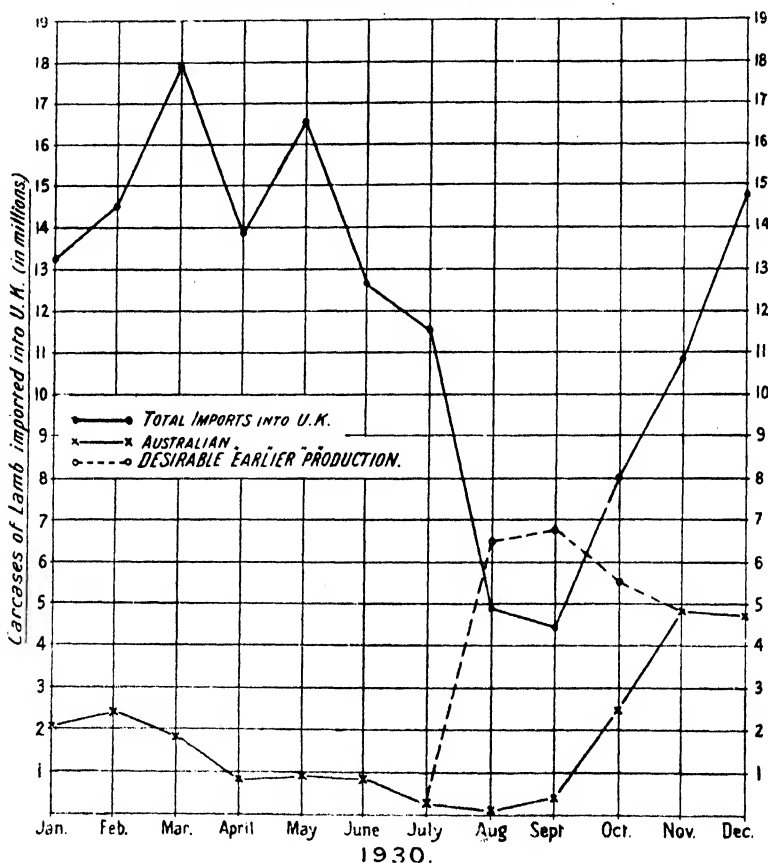


These two advantages of colour and earliness enjoyed by Western Australia must be utilised to the utmost, and an effort should be made to change the direction of the curve representing the exports from Australia to that represented by the dotted line in Diagram H, so as to provide that the export of lambs from Western Australia shall commence as early as possible, and as many as possible be sent away so as to arrive in England during the period August to November, when the imports from our competitors are at their lowest. In this fight for more remunerative returns it is not sufficient to take advantage of our geographical position; the quality of our lambs must be improved. It will be seen from Diagram F that in February, when the new season's Canterbury lambs came on to the market, their selling price was 2d. per lb. better than the Australian price because of better quality. If Western Australia is to have its proper share of the British market then it must produce export lambs which, as regards uniformity and quality, are equal to New Zealand, so that the West Australian lambs can meet the New Zealand ones at the same time on equal terms.

The production of export lambs has special advantages for the agricultural areas; in the first place it ensures the maximum number of sheep being carried when feed is most succulent and abundant, and the minimum when it is scarcest and driest. Further, the crossbred mother, for which there is a keen demand, produces excellent wool, and is very suitable for farm conditions; it is an infinitely better scavenger than the Merino, and therefore better adapted to assist in cleaning the fallowed land.

DIAGRAM "H."

**GRAPH SHOWING IMPORTS OF LAMB INTO U.K.:  
TOTAL AND AUSTRALIAN, 1930.**



Farmers have realised the necessity for a change in their sheep husbandry, as evidenced by the export of lambs in 1922 and 1923 already referred to, and through the courtesy of Mr. Gray, of Messrs. Elder, Smith, & Co., Ltd., I have ascertained that 60,520 lambs were marketed at the Metropolitan markets between the months of July and November, inclusive, in 1929, and 161,860 in 1930; of these latter 23,231 were exported. It is expected that this year there will be from 40,000 to 50,000 (only about 6 per cent. of the surplus) available for export. These are, however, of many types, and there are far too few of those for which the highest price is obtained. This must be altered so that there is much greater

uniformity and general improvement in type by standardising the methods of lamb production.

In the September, 1930, report of the London Veterinary Officer, previously referred to and relative to the "Yarrawonga" lambs, he implies a "good-will" due to a reputation not only for "quality" but for "*uniformity*," and, in our desire to obtain a footing on a crowded market the fact that this is recognised and paid for must be utilised to the advantage of the State. Our aim must be to develop a special uniform type of lamb to be known, say, as the "Swandown Lamb," similar in quality to the "Yarrawonga" Southdown crossbred lamb, and to achieve a reputation for it.

With the experience of the past to guide us it is believed that, for the conditions which obtain in the major portion of the agricultural areas, the Border Leicester is better adapted for mating with the Merino than any other breed of the Longwool group, and similarly, the Romney Marsh for the wetter districts where foot rot is feared; the ewes resulting from either of these crosses to be mated wherever it is possible with Southdown rams.

The experiments conducted by Colebatch & Scott at the Roseworthy Agricultural College supply some very useful information regarding the financial returns likely to result from such a policy as outlined. From Table X. it will be seen that the most profitable returns were obtained from the cross which is in most demand upon the British market, and which is obtained by mating the Southdown with the Border Leicester-Merino ewe.

TABLE X.  
MONETARY RETURNS FROM SALE OF LAMBS.

Ram.				Ewe.				Value of lambs (per 100 ewes.)			Lamb pelts (per 100 ewes.)			Net return from each flock (per 100 ewes.)		
								£	s.	d.	£	s.	d.	£	s.	d.
Merino	...	...	...	Merino	...	...	...	78	0	2	26	9	4	163	0	2
Lincoln	...	...	...	Merino	...	...	...	104	8	9	26	6	6	189	8	9
English Leicester	...	...	...	do.	...	...	...	107	4	7	27	13	1	192	4	7
Border Leicester	...	...	...	do.	...	...	...	111	17	3	26	0	7	196	17	3
Romney Marsh	...	...	...	do.	...	...	...	82	11	4	21	14	4	167	11	4
Dorset Horn	...	...	...	Merino	...	...	...	92	5	6	20	13	4	177	5	6
Shropshire	...	...	...	do.	...	...	...	92	11	7	21	6	3	177	11	7
Southdown	...	...	...	do.	...	...	...	99	19	9	21	3	6	184	19	9
Dorset Horn	...	...	...	Border Leicester-Merino	...	...	...	127	15	3	27	0	4	198	3	7
Shropshire	...	...	...	do.	...	do.	...	119	1	3	25	16	8	189	9	7
Southdown	...	...	...	do.	...	do.	...	131	10	8	27	1	0	201	19	0

From Experiments at Roseworthy Agricultural College, South Australia.

This was closely followed by the cross Dorset Horn x Border Leicester-Merino ewe. From this table it will also be seen that, with the exception of the Romney Marsh, it was more profitable to mate the Merino with the Longwool breeds—Border Leicester, English Leicester and Lincoln than with the Shortwool or Downs breeds, though of these latter the Southdown, when mated with the Merino, proved the most profitable; the pure Merino was the least profitable. The prices for both wool

and carcase then ruling were very decidedly better than at present and were—for Merino wool AA fleece 21½d. ; for cross-bred wool AA fleece 20d. The average price per lb. obtained for lambs of first quality—28lb. to 36lb.—was approximately 10d. per lb.

Because of the crossbreeding which is essential the production of export lambs is not as simple, nor as easy, as that of raising Merinos ; to produce the necessary type involves the production of three separate types of sheep—

- (a) the Merino ;
- (b) the Longwool x Merino mother ; and
- (c) the Down export lamb.

The production of these three distinct types is too complicated for the average farm, but, if the general State policy for the production of export lambs is such that each section is treated separately and specially, and allotted to the districts best adapted to each, the position is immensely simplified and presents no difficulty to any farm.

Under such a system each breeder would undertake the production of one type only and generally the production would be as under—

The pastoral areas would produce the Merino mothers ;

The outer wheat areas the Longwool mothers, and

The inner Wheat Belt and the Clover Belt the Export Lamb.

Such a system would have the added advantage that, though the pastoral area cannot raise the export lamb, and therefore directly benefit by its production, it would indirectly and materially benefit as the result of supplying the Merino mothers for the Longwool crossbreds, and thus find a market for some of its otherwise surplus sheep. The outer Wheat Belt would dispose of the wethers as export lambs and the ewes to the breeders of the "Swandown" export lambs.

The conclusion is inevitable that there is no market for our surplus sheep in their present form. To secure a market it is necessary to change the character of our sheep husbandry in the agricultural areas, but this can be done without economic loss. The production and export of fat lambs to the market of the United Kingdom offers the only solution of the problem of our surplus sheep.

To meet the requirements of the British market the export lamb must be marketed as a "sucker" direct from its mother ; this is also necessary for economic reasons, as this type of lamb is an unprofitable wool producer and cannot, therefore, be carried profitably through the spring and summer until it is older. In this respect it is quite unlike its crossbred mother, but from the State's standpoint it is an advantage rather than a disadvantage, for it means that the export lamb raiser does not retain any of the young stock to carry on his operations, and hence the surplus in the pastoral areas must be utilised to meet the demand for breeding stock.

This is also essential to minimise the severe competition in an over-supplied local market, because this phase of the sheep industry offers as great or greater financial returns than the production of Merino wool ; it is also well suited to our climatic conditions and at the same time it has the economic advantage that it provides an outlet for some of the surplus sheep in the pastoral areas. It is hoped that it has been shown that this can be done with economic safety, for it will necessitate the further development of, and increased expenditure on our farms, but, because of the developed state of our farms, the increased expenditure is only a fraction of what would be necessary if the development for this export trade had to start *ab initio*. With the increased expenditure there would be resumed, at least in part, that development which had to cease in both agricultural and pastoral

areas with the collapse of the wool market, and thus the profitable disposal of our surplus as Export Lambs not only offers relief to the pastoralist and agriculturists but in its train provides profitable work for the unemployed, and so relieves a congested labour market.

Summed up the position is—

1. There is a sheep surplus in the State of over 800,000 for which there is no export market in its present form.
  2. There is an export market in the United Kingdom for lambs of a suitable type.
  3. New Zealand until recently obtained best prices with "Canterbury" lambs, *i.e.*, English Leicester x Merino crossbred lambs.
  4. This position has been successfully assailed and improved export lambs produced by mating the "Canterbury" type ewes with Southdown rams.
  5. This type can be produced in the agricultural areas by mating the Southdown with the Longwood Merino crossbred ewe.
  6. Western Australia has an advantage over Eastern States competitors in this market because our season is earlier, and the distance from the market shorter; in consequence, the State is very favourably situated to attack the market when its imports are at the lowest.
  7. Because of the competition due to an abundantly supplied market it is essential to supply the best quality for which the British consumer is prepared to pay.
  8. Western Australia can and must produce the same type, and earn a "reputation" for it.
  9. This will involve the production of lambs of uniform and standardised quality, and requires a State-wide policy with regard to the breeding of the Export Lamb.
  10. Results at Roseworthy have shown that better financial returns will accrue to farmers working along the lines suggested.
  11. The West Australian lamb, in common with that of other Australian States, has an advantage over the New Zealand lamb with regard to colour, and this will bring enhanced prices.
  12. The economic aspect of the industry will be improved by changing the character of the sheep husbandry in the agricultural districts, and thus directly removing the surplus from them, at the same time providing a market for at least some of the surplus sheep in the pastoral areas.
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## "KOORABBIE" METHODS.

A. M. RUDDUCK, "Koobabbie," Coorow.

The first essential in the raising of fat lambs is to secure suitable mothers, *i.e.*, crossbred ewes of the right type. For this purpose large-frame Merino ewes are mated with Border Leicester rams. The wether lambs are sold as suckers and the ewe lambs retained for breeding purposes. When mating Border Leicester rams it is not desirable to place the full number of rams with the ewes; if this is done the rams run by themselves and neglect the ewes. Yarding with the ewes at night has been tried, but the method now adopted is to introduce the rams singly; as each one joins the flock another is added until the full complement is reached. Two per cent. of healthy, vigorous rams is sufficient.

These crossbred ewes are mated as two-tooths with Dorset Horn, Southdown, or Border Leicester rams. The whole of the lambs from the above are sold as suckers; the ewe lambs could probably be used to produce good mothers, but from a wool-producing point of view they would be undesirable to carry as ewes from year to year.

The feeding of the ewes during the dry months is a point of great importance, and receives due attention. They are run on natural pastures until the stubbles are ready. When these are finished the ewes are returned to the grass paddocks; these are never eaten bare and always have some feed on them during the summer. Hand-feeding is resorted to while there is still plenty of natural feed. By providing a choice of food in this way the amount of waste during the hand-feeding period is negligible. Hay is used supplemented by a small quantity of oats or wheat. The crop is cut for hay when just past the flowering stage, and both oaten and wheaten hay are used successfully. Commercial feeding stuffs like linseed cake have been tried, but as hay, oats, and wheat are grown on the farm and produce prime lambs the use of purchased foods appears uneconomical.

The feed is placed on the ground, not in feeders. The quantity of hay and grain feed depends upon the supply of dry feed remaining in the paddocks, and varies from  $\frac{1}{2}$  to 1 lb. of hay and the same weight of oats or wheat per day. The period between the first rain and the advent of grass is always most difficult for hand-feeding, but given a good fall of rain at the opening of the season, followed by showery, moist weather, some of the paddocks will carry a ewe to the acre a week after the first fall. The feed is then young barley-grass supplemented by the old dry feed.

Oats are sown each year to supply early feed for the ewes and lambs, but they much prefer to be moved over fresh grass paddocks. Past experiences have proved to us that it is inadvisable to feed off wheat crops, lest we should have a light rainfall or an early spring. If such should occur the wheat yield is reduced by feeding back. Here it may be mentioned that the paddocks have been liberally treated with superphosphate. Without this few lambs would be fattened, and certainly not for the early market.

The lambing paddocks each contain about 100 acres, and when the lamb-are dropping the flock is each morning moved to a fresh paddock, leaving behind, for a day or so, those ewes which have lambed during the previous 24 hours, after which they are moved to feed as good as the season permits. As far as possible the mothers are kept in groups of about two hundred for the convenience of lamb-marking and to facilitate moving to fresh pastures.

When the lambs are ready for market they are taken from their mothers on Monday morning, driven five miles that afternoon, yarded for the night, driven

eight miles next day, placed in the truck by 4 o'clock, and, after a rail journey of 152 miles, sold at Midland Junction market on Wednesday.

Particulars of the rainfall during the growing period, the methods of mating and results of the marketing of lambs for the past three seasons will prove of interest. They are as follow:—

#### RAINFALL.

Year.	Mch.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Total for year.
1929 ... ..	10	0	373	334	13	78	10	50	1,266
1930 ... ..	114	155	55	598	254	119	68	82	1,471
1931 ... ..	30	92	232	98	243	120*	...	...	...

\* Up to 25th August.

The first useful rains were as follows:—

1929—2nd May, 16 points; 3rd May, 88 points.

1930—16th April, 24 points; 18th April, 18 points; 19th April, 90 points.

The splendid April rain lost much of its value owing to the long dry spell that followed, the balance of April and the whole of May supplying but 57 points.

1931—7th April, 47 points; 12th April, 20 points.

Both these falls were showers induced by thunder, and fell over a very limited area. The season broke on 4th May, when 138 points were distributed over four days. June was dry—98 points only—and cold, with heavy frosts. The feed was short and discoloured.

In the respective years the ewes were mated and the lambs marketed as follow:—

1928—Rams joined with ewes 30th November and 1st December.

Lambs sold at Midland Junction, 1929:—

—	July 31st.	Aug. 7th.	Aug. 14th.	Aug. 28th.	Sept. 4th.	Sept. 11th.	Sept. 18th.	Sept. 25th.
Number ...	40	160	70	82	163	175	27	11
Prices ... ..	29/7	27/7 25/1	24/10 23/10	27/4 25/10	20/4 18/10	22/4 18/10 18/-	16/1	16/10

1929—Rams were joined with ewes 30th October and 2nd and 11th November.

Lambs sold at Midland Junction, 1930:—

—	July 2nd.	July 16th.	July 23rd.	July 30th.	Aug. 6th.	Aug. 13th.	Aug. 27th.	Sept. 10th.	Sept. 24th.
Number ...	80	160	125	160	234	236	60	80	39
Prices ... ..	22/4 21/4	20/4 18/1	18/7 18/1	15/7 14/10	20/1 18/1 17/1	17/10 16/4 14/4	14/7 13/10	16/7 16/1 14/-	12/10 10/10

(Some of the lambs each year were first cross, *i.e.*, the progeny of Border Leicester rams from Merino ewes.)

1930—Rams were joined with ewes as follows:—

Flock A—300 crossbred ewes—

1st November—6 Southdown rams.

Flock B—760 crossbred ewes—

1st November—7 Dorset Horn rams.

16th November—3 Border Leicester rams.

17th November—6 Dorset Horn rams.

The mating procedure in connection with the ewes to be joined with Dorset Horn rams was adopted because it has been found that with that breed, if too many rams are placed with the ewes at the beginning of the mating season, there are not enough ewes to go round and then the rams fight and disable themselves, sometimes permanently.

The dates hereunder on which the lambs were born in 1931 may be of interest. The figures represent the lambs counted each day, and are approximately correct:—

March 31—2.

April 2nd, 2; 3rd, 1; 6th, 5; 7th, 2; 8th, 16; 9th, 8; 10th, 6; 11th, 7; 12th, 11; 13th, 10; 14th, 22; 15th, 23; 16th, 23; 17th, 44; 18th, 43; 19th, 40; 20th, 90; 21st, 56; 22nd, 80; 23rd, 61; 24th, 44; 25th, 40; 26th, 30; 27th, 45; 28th, 30; 29th, 30; 30th, 12.

May from 1st to 8th, 91; from 9th to 19th, 61; from 20th to 29th, 32.

The balance were dropped in June and July.

For the present season 1,060 crossbred ewes were mated. From these 1,051 lambs were marked. Some lambs died at birth; foxes killed others. About 50 ewes were not in lamb. Three ewes died through lambing troubles. Two ewes died later in the season from an unknown cause. Thus the loss from 1st November to 30th June—eight months—was 5 ewes.

The lambs were sold at Midland Junction, 1931—

—	July 8th.	July 15th.	July 22nd.	July 29th.	Aug. 5th.	Aug. 19th.	Aug. 26th.
Number ...	80	117	180	180	162	132	152
Prices ...	15/4 14/10	16/10	15/7 15/1 15/-	15/10 14/10	16/4 15/7	14/- 13/10	15/4 14/10

The consignments sold on the 8th and 22nd July were stained in the trucks, and it is estimated that, because of this, the prices realised were reduced by 1s. to 1s. 6d. per head, and this was a direct loss to the producer. Since that time tarpaulins have been secured each week to protect the lambs.

Our experience to date is that the lamb sired by the Dorset Horn ram matures about two weeks earlier than those sired by other breeds. Lambs have been sold at ten weeks, but twelve weeks is about the average age of marketing. Twin lambs, unless the mother has a heavy flow of milk, mature later than single lambs.

## THE EXPORT FLOCK AND ITS CARE.

W. G. BURGESS, "Tipperary," Burgess Siding.

Having first obtained the right type of ewe, and that must, in my opinion, be the progeny of the Longwool British-bred ram from a large-framed Merino ewe, the next thing to consider is the mating and feeding.

Ewes should always be kept in good healthy strong condition, and about ten days before mating should be given some fresh, good pasture and kept in good order during the mating period. I would suggest not more than 250 in each flock, and first put in, say, four rams and follow on in 14 days' time with the balance;  $2\frac{1}{2}$  to 3 per cent. will be found the best percentage of rams to be used. This will get a more even drop than using a small number of rams. Only use one breed of ram to each flock (it is sometimes advisable to put in a vigorous worker like the Dorset Horn towards the end of the period to ensure all ewes being in lamb). Should any of the rams be falling away, take out and feed up for a few days and then put back again. This will often save the loss of a ram later on. Keep rams in from 10 to 12 weeks. Shear and dip rams early; also dip ewes at least one month before mating.

A month before lambing (this entirely depends on the season) ewes want extra feed, and at this period care should be taken that they do not lose condition. If the ewe at this period is allowed to fall away it will have a detrimental effect on the future lamb. Crutch ewes at least one month before lambing.

During dry weather the ewes may be fed on the ground, taking care that the fodder is distributed on a fresh place each day and the more grass it is put on the better. It will be found that, if this is carried out, feeding dry oats will be the most economical. Starting early, 4ozs. per day will keep the ewes in excellent order. Wheaten or oaten hay (the hay should not be from fallow) are useful fodders, but there is always a little waste from hay.

The worst period to feed is after rain. Here feeding on the ground is wasteful and I suggest bag feeders as the most economical, giving the ewes from  $\frac{3}{4}$  to 1 lb. of chaff and 6 to 8 ozs. of oats added.

Care must be taken to see that the whole of the flock can get its proper share of the ration. The objection to automatic feeders is that they afford special opportunities for the stronger ewes to get too much feed at the expense of the weaker sheep, which get tired of coming along and failing to get their ration. Further, the lambs get badly boxed and trouble generally occurs.

Silage is most useful mixed with a little chaff or oats, but I cannot advise putting up expensive silos at this period. If the ewes are kept strong by feeding before the wet weather comes along little trouble may be expected when the rains come.

During lambing the ewes should have attention first thing in the morning and last thing at night. This will repay a man's time over and over again in the saving of mothers and lambs.

The lamb having been dropped, mark every three weeks. When yarding for this purpose be careful to leave all young lambs behind in the paddock.

Draft all dry ewes when lambing is finished. They are eating your best feed, which the mothers require, and further, often get too fat and do not get in lamb the following year. I consider it a good plan to sell the older dry ewes to the butcher.

From now on the ewes and lambs should be kept on the best of pastures, and must not receive a check in any way. Growing oats is of very great assistance;

pasture should, however, be available. It is advisable not to have the crops on too wet land, otherwise in cold frosty weather the lambs may get sore-footed, which would easily throw them back a fortnight.

When the lambs are fit to market, draft off from the mothers; the lambs can then be hand-picked without undue knocking about. Great care must be taken in not grabbing the wool or legs, otherwise bruises will result. It will generally be found that about 30 per cent. of the lambs will be ready at one time. To save your best feed it is advisable to take off the mothers of the lambs sold. This can be done by putting the ewes in a small field near the drafting yard. The mother will make back to the yard and then can be run off. To make sure no error has been made, place the ewes with lambs in one field and the other lot in an adjoining field, and, if there are a few on the wrong side, they can easily be found the next morning.

One of the greatest mistakes most of us make is overstocking. It should be realised that it is much better to have two first-quality lambs than three medium ones. It is also a bad proposition to fatten a number of wethers on your stubbles and starve the prospective mother.

Summed up, the position is:—

1. Get a good crossbred ewe;
2. Use only one breed of ram in each flock;
3. Keep ewes in strong, healthy condition;
4. Flush with good feed just before mating;
5. Look up ewes morning and evening during lambing;
6. Feed well after lambing;
7. Grow oats and other suitable pastures; and
8. Handle lambs carefully during marketing.

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## IN QUEST OF THE EARLY "SWANDOWN" LAMB.

E. H. B. LEFROY, "Cranmore Park," Walebing.

This is such a new country with so many problems to face, and there has been so little time for really thorough investigation by anyone, that no greater harm could be done than by attempting to dogmatize. All that can be done safely is to say: "These are the things I have seen, these are the places I have seen them, such are the conditions under which these things were seen and such are, to me, the apparent results."

A trap into which all of us who have spent our time on the land are liable to fall is that we imagine we know, whilst really we only think we know. The circumference inside which most of us work and think and observe is necessarily a small one, so that if, after many years of experience in one small circle we become arrogant in our opinions and in our attitude towards the expressed opinions of others, perhaps we may be forgiven by those who are broadminded enough to make allowances. And when I accede to a request to write this little article let it be understood that I merely set out to state some of the results of my own experiences and the experiences of those with whom I have come in contact under Western Australian conditions, particularly in the Moora District, during the last 22 years.

It is desired that this contribution should touch on the subject of a rational sheep policy for adoption by the Agricultural and Southern areas of Western Australia, with a view to the best interests of the State and of the industry. There is great scope for such a subject, and much more ground needs to be covered than such an article as this could hope to deal with adequately.

So far as the sheep industry in Western Australia is concerned, certain things seem pretty definite:

- (1.) We are faced with an alarming surplus sheep problem.
- (2.) Development in both the Pastoral and Agricultural Areas to enable the State to carry more sheep has stopped dead, and any early increase in our sheep-carrying capacity seems improbable.
- (3.) It appears unlikely that breeding sheep in our farming areas for wool and for the local mutton market only will be profitable in that future which we are able to visualize.
- (4.) There is a market for lambs of the RIGHT QUALITY in London.
- (5.) The competition on the world's market for lambs is becoming fierce and increasingly so.
- (6.) Western Australia has a special advantage over other lamb exporting countries, owing to the time of year our lamb season occurs, **provided we send our lambs away early.**
- (7.) Under proper management (breeding and feeding) our farmers can produce the lamb London favours.
- (8.) The favoured lamb is of the Downs Cross.
- (9.) The pre-eminently favoured lamb for Australian export is the product of a Southdown ram from a ewe of the Longwool-Merino type.

Although our experience is not by any means so extensive as we might like in connection with the Southdown crossbred lamb, we have data which encourages us to believe we can make a success of the production of this ideal lamb. There

is reason to hope that Western Australia can produce this type of lamb, and that a reputation for quality can be achieved with it. So as to secure the full advantages of such a reputation, if the anticipations be realised, the special type should have a distinctive mark or brand, for which the name "Swandown" is suggested.

Though Smithfield (London) places the Southdown cross lamb on the top, and the best lambs from Australia and New Zealand are of that cross, it is not safe to assert definitely that Western Australia will make her greatest success in lamb breeding as the result of using the Southdown, even though an endeavour is being made to produce the best and compete successfully with other countries.

The "Swandown."



Southdown-Border Leicester-Merino.  
Tipperary, 1931.

It must be pointed out, however, that since the competition in this trade will inevitably be so great, nothing but the best will help us much. The best will always find a market.

Now we do know about the Southdown that he is slower in reaching the export age than several other breeds, and amongst these breeds of quicker maturity is the Dorset Horn particularly. Further, the experience of some breeders indicates that the Southdown ram is not so prolific as that of some other breeds.

The experience of Mr. C. L. E. Orton, of "Petworth Park," Moora, has been much in favour of the Southdown ram as a sire of fat lambs. Mr. Orton has been a careful and successful breeder of fat lambs for over 20 years at his property, "Petworth Park," and he has experimented with a number of English breeds of rams. Although he readily admits the Southdown is slower in maturity than several of the other breeds, he quite definitely places this ram in the first place. He has found him particularly vigorous and prolific. A larger percentage of exportable lambs are obtained from his drop than from any other breed. In fact, as one who has had the opportunity of making special inquiries at Smithfield and one who has a good knowledge of English requirements and English sheep breeding practices, Mr. Orton, for the purpose of breeding his own lambs for the Smithfield market, is a straight-out and convinced Southdown man. So much so that arrangements have been made by him for the importation of stud ewes and rams of the breed for use on "Petworth Park."

My own visit to Smithfield left no room for doubt as to the importance of the Southdown. So it is hoped the Southdown will be given every chance to prove his worth in Western Australia.

There can be no doubt about the advisability of commencing **early** with the export of lambs from Western Australia, and bound up with this is the debated question of Early or Late lambing. In view of the value of the Southdown as a sire of export lambs, and as this breed matures more slowly than the Dorset Horn, this matter is of particular interest. There are two schools of thought about this matter; there is the Early school—those who advocate that the lambs should be dropped, say, from the middle of March to the beginning of May, and the Later school—who believe that lambing should be delayed until May or June, when there is every probability that there will be green feed for the lambing ewes. Of this, like many other matters, it may be said that both are right **sometimes**. It depends entirely upon circumstances.

My belief is that a definite period for lambing should be fixed to suit the circumstances. Proper provision should be made for a successful lambing at the time decided upon as being the most suitable. Some of our most successful breeders are mating early in November. Usually the result from mating at that time would be that the bulk of the lambs drop between the middle and the end of April. Queer things do certainly happen at times, sometimes not easily accounted for, and, in consequence, there can be no certainty as to how quickly ewes will become in lamb. In making statements as to how long it will be before lambs will drop after mating we are necessarily guided by the rules which govern such cases, and which are founded upon probabilities. The exception has annoying habits at times.

To begin with, no farmer who hopes to make a success of export lamb production can do other than handle the stock on his farm on rational and conservative lines. His sheep must at all times have sufficient feed of some kind. Suitable water, even though it may be a little salty, is essential.

With regard to lambing dates, the circumstances now being discussed seem to demand that, for maximum results, the earlier lambing should be adopted. It is advisable that advantage be taken of the better prices obtainable in London for the lambs exported in the early part of the season, and, therefore, provided breeders are prepared and able to make the necessary provision of feed for their ewes, I have no hesitation in recommending the earlier lambing produced by mating, say, from 10th to 15th November.



**For Early Lambing.**—Preparations should be well in hand before lambing commences. Crutching should have been carried out and feeding to supplement the natural grazing already commenced.

To successfully carry out early lambings it will be found necessary on most farms to provide some feed other than the natural pasture for the use of the ewes when lambing. Where there is good oat stubble with some good dry clover it may not be necessary to supplement this with other feed, but it nearly always pays to do so.

As to how to feed the ewes most successfully and most economically is a very open question. It probably would be true to say there is no best way. So much depends upon circumstances, what feed the farmer can most economically grow, whether it is a good season, whether he has much old natural feed, etc. But let it be assumed that the conditions are those of an average farm inside the typical fat lamb raising areas, say, the 15 to 20 inch rainfall country; the farm has not been overstocked; that there is fair old natural feed on the ground, and that there is also on hand some green chaff from hay cut in the flowering stage, and not from a rank crop. My experience is that chaff cut short from either wheaten or oaten hay of suitable variety ("Burt's Early" oats and "Baroota" wheat) will make excellent sheep feed. No doubt others have found other varieties equally suitable and prefer them.

It can also be reasonably assumed that most farmers, in addition to producing chaff, can even more easily make provision for a supply of grain for their sheep. An economical method of storing oats is in bins to hold, say, 500 to 1,000 bags.

Chaff and oats are natural and economically produced feeds under the commonest conditions in Western Australia. There is, of course, silage, and some can grow peas successfully, and again, in some places lucerne has a place to fill. Perhaps someone else will tell us about those things. The majority of farmers have not reached that stage yet. Nor can the comments of the lupin enthusiasts be ignored. Lupins, too, appear on the horizon but have yet to arrive, so far as most of our farms and many of our farming districts are concerned. For the present let us make the best of what we have, while seeking always for something better. Chaff and oats are within the reach of most farmers.

Oats appear to have special virtue as sheep feed. It gives the sheep "kick" and strength, and seems to provide a great deal of what mere chaff or other dry feed lacks. The sheep may not look any the better for having oats at the time of feeding, in fact a lot of bulky stuff is often deceptive as it makes the sheep look full, whereas a smaller but more nutritious ration containing oats may not show the sheep to the same advantage. The great benefit is seen after the rains come and the sheep get on to the green feed. Diluted with good chaff, oats make a good ration. It is economical and gives satisfactory results. I have been told that oats are not nearly so good as potatoes, onions, lucerne, linseed and what not. That is all right, perhaps, if you have money with which to buy luxuries, but we are trying to make the best of what we can reasonably grow.

What quantity per day should the ration of chaff and oats consist of? The best reply to that is to see what your ewes require to keep them well. It would be foolish to lay down a definite amount. It may be suggested, however, if the ewes are still in nice condition and if there is still a fair amount of bulky dry natural feed, that a half pound of oats per day and a quarter pound of chaff, will

probably suffice. This is not merely a guess. If there is no dry feed, more chaff will probably be needed. For more generous feeding add more oats. If short of oats even a quarter pound with the quarter pound chaff is a great help. The last issue of the Journal of Agriculture had some helpful figures on the subject of feeding and included the use of silage.

Long hay, cut green and fed on the ground or in racks, is the menu provided by some farmers for their sheep. It certainly saves a lot of chaffcutting, but I am inclined to believe is the line of least resistance and lesser results. Although it is by no means an uncommon practice and appears to be preferred by some people, we do not give this method pride of place. That is probably a matter of opinion and not a matter of the greatest importance. Both methods have their advantages and their disadvantages. I do not not recommend automatic sheep feeders.

If using feeding troughs for the chaff and oats the usual way is to erect two parallel rows of posts, say 10 inches high, and about 16 feet apart in the rows. Bore a hole near the top and run wires through to hold bagging. Split old cornsacks or sound super bags longways and sew together, thread the wire through the edge of the bagging. Make a sharp point on the wire so as to thread easily. The feeder should touch the ground so as to take the weight and save wear. Allow one foot in length for each ewe, *i.e.*, 100 ewes per 100 feet of feeder. They don't take long to erect. Keep a needle and some hay bands at each feeder for a stitch in time.

Jarrah seconds 9 x 2 for bottoms and 9 x 1½ for sides, in lengths up to about 10 or 12 feet make fine permanent feeders. It is a good plan to fasten hoop iron around the ends of these with screws.

As to how long before lambing should the feeding commence, and how long after rain should it be continued, must be decided by circumstances. There are some seasons, when rain comes early and is followed up, when feeding is not necessary. Unfortunately this is not often under Western Australian conditions. But although nature has given us a long dry summer we are blessed with conditions that make the provision of some artificial feed relatively easy and practically assured. It is the rarest event for the safer parts of our agricultural country to experience a really dry winter and spring. We know, almost for certain, that the conditions will be droughty in March and April and often into early May. But in the methods indicated we have means whereby provision for this can be quite well arranged and thus make it possible to have the lambs well on their feet by the time natural green feed is available. These provisions it seems must form an important and accepted part of any successful system of sheep keeping that may be evolved.

This article does not set out to give the last word in anything. There is much to be learned by all of us. It is only by the dissemination of the results of our reactions to experiences that the sum of general and useful knowledge can be added to. It is, however, hoped that the contribution of this mite may be at least of some help to those who have been less fortunate in their opportunities for first-hand observations.

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## CONFORMATION AND TYPE OF EXPORT LAMB.

HUGH MCCALLUM,  
Sheep and Wool Inspector.

The fact that the Merino ewe is the foundation of the fat-lamb industry in Western Australia cannot be overlooked, and to make a success of lamb-breeding for the export trade special attention should be given to the selection of the parent ewe. Uneven, nondescript flocks cannot produce the uniform type of lamb the trade demands. The flock to be used for lamb production should consist of ewes of sound constitution, plain bodied, of big girth, flat withers, well-sprung ribs, and with plenty of depth through from shoulder to shoulder, presenting an appearance of symmetrical proportion and good conformation. Ewes which develop a good milk supply should be marked and those which fail in this respect culled out of the breeding flock.

From a good flock of Merino ewes, by judicious mating to pure-bred British Longwool rams—as recommended by the Department—can be produced good type half-bred ewes. These should be carefully culled and only the best retained for breeding purposes. All half-bred male progeny must be fattened and killed. Half-bred ewes, unlike pure bred, rarely, if ever, possess all that is characteristic of the parent flock. Generally, however, the ewes of the best conformation produce the best wool and the most desirable lambs.

All breeds of British Longwool rams, when mated to the Merino ewe, produce lambs which show characteristics distinguishing one cross from another. The Border-Leicester is a long-bodied lamb, good in conformation, rather leggy but with good hindquarters and shoulder, of big girth with deep and well-formed chest. The Lincoln lamb on the whole is the most regular in outline, with wide shoulders and deep wide chest. The Leicester is short of body with good hindquarters, but the forequarters and brisket are not so prominent as in the Border Leicester or Lincoln. The Romney Marsh is of large depth of body, shoulders wide, and the half-bred shows an improvement in the flesh on the back and ribs.

The use of the Romney Marsh ram is recommended in wet, marshy areas as this breed is very resistant to foot-rot and fluke.

By mating the selected half-bred ewes to the Southdown, Shropshire or Dorset Horn rams, the lambs produced will be earlier maturing than the half-bred. Given satisfactory conditions these lambs quickly develop and when dressed present the small-boned, plump, meaty carcass so necessary to meet the demand of the British consumer.

### SELECTION OF BRITISH BREED RAMS.

Quality lambs can only be produced by mating the ewes to sires of pure blood. Rams of doubtful breeding must be avoided as an undesirable sire cannot be expected to throw satisfactory lambs. The following are the main points to be considered when judging the quality of sires of the various breeds:—

*Border Leicester.*—This is a rather leggy sheep with a long barrel-like body, of straight underline and has a stately carriage. This breed has given ample proof of its ability to thrive on a wide variety of pastures under differing climatic conditions, and in these respects it is, perhaps, a more versatile sheep than its long-woolled fellows.

*Head.*—Hornless, fairly long with a wide forehead, slightly Roman nose and dark nostrils.

Neck.—Of medium length, muscular, tapering evenly from the head and well set in at the shoulders.

Shoulder.—Wide and deep.

Wither.—Smooth and well rounded.

Chest.—Very full, prominent brisket, denoting plenty of heart room.

Back.—Very broad and straight and long with ribs well rounded.

Hindquarters.—Rump round and meaty, hips wide and level with moderate flank.

Legs.—Clean and covered with white hair, the hoofs are black.

Covering.—Good length of staple, showing character and lustre and an absence of bare skin. Average counts 46s. Merino-Border Leicester counts 50-56s.

*Lincoln*.—A large bodied sheep which grows the strongest and heaviest fleece of all British sheep.

Head.—Hornless, massive with deep jaw, clean white face, dark muzzle and a wide-covered forehead, prominent forelock.

Neck.—Of medium length, thick at the base and well set in at shoulders.

Shoulder.—Wide and large.

Chest.—Wide and fairly deep.

Wither.—Well arched and roomy.

Back.—Fleshy and fairly long with well sprung ribs.

Hindquarters.—Broad and fleshy, hips wide and level and full flank.

Legs.—Large boned with flat knees and strong black hoofs.

Covering.—Fleece shows character and lustre, is long in staple and very heavy. Average counts, 32s.-36s. Merino Cross counts, 46s.-50s.

*English Leicester*.—A rather leggy large-framed sheep which matures early and fattens rapidly.

Head.—Hornless, rather small, black muzzle, clean white face with cap of wool on forehead.

Neck.—Short in length, slightly arched and muscular.

Shoulder.—Broad, full and very fleshy.

Wither.—Level with back and fairly broad.

Back.—Fairly long and broad with a fleshy loin and cask-like ribs.

Hindquarters.—The rump is prominent, hips fairly wide and rather small flank.

Legs.—Long and wide apart with large black hoofs.

Covering.—Fleece of good length and lustrous and there is an absence of bare skin. Average counts, 40s. Merino Cross counts, 46s.-50s.

*The Romney Marsh*.—This is a large-framed sheep, and is very popular in wet, low-lying areas on account of its ability to resist foot-rot and fluke, which diseases are usually common to such localities.

Head.—Hornless, level between the ears, black muzzle, clean white face and a forelock of wool.

Neck.—Very short, strong and thick.

Shoulder.—Wide, large and fleshy.

Chest.—Fairly wide and deep.

Wither.—Well rounded and level with the back.

Back.—Straight and broad, ribs well-sprung and loin flat and meaty.

Hindquarters.—Rump well rounded and heavy, hips wide apart and flank fairly broad.

Legs.—Short and big boned.

Covering.—Dense and of even quality. The cross with the Merino produces an excellent fleece. Average counts, 46s.-50s. Merino Cross, 56s.-58s.

*Southdown*.—A small-boned sheep which is very hardy and a good traveller. It yields mutton of excellent quality.

Head.—Hornless and level between the ears with a full, short face and short wool covering the forehead.

Neck.—Short, thick and fleshy, tapering slightly towards the head.

Shoulder.—Well set up, large and fleshy.

Chest.—Very deep and wide.

Wither.—Smooth and slightly arched.

Back.—Level and broad with a wide flat loin, well covered with firm flesh, ribs wide and well sprung.

Hindquarters.—Very deep and weighty with wide roomy hips and full flank.

Legs.—Rather short and wide apart, hoofs black.

Covering.—Of fine quality and densely covering the whole body down to the hocks and knees. Average counts, 54-56s.

*Shropshire*.—A medium-sized sheep noted for hardiness of constitution, tendency to early maturing, and adaptability of varying soils and climates.

Head.—Hornless, black muzzle, short face with broad forehead covered with wool.

Neck.—Rather short but thick and muscular.

Shoulder.—Large and fleshy.

Chest.—Very full and deep.

Wither.—Wide and rounded.

Back.—Broad and straight, loin wide, ribs well-sprung and very deep down the sides.

Hindquarters.—Rump well rounded and fleshy, hips broad and full flank.

Legs.—Short, stout and widely placed, covered to knees and hocks with dark soft hair, hoofs black.

Covering.—Dense and of medium strength. Dark hairs sometimes show in the fleece, but this is most undesirable. Average counts, 50s. to 56s.

*Dorset Horn*.—A large-bodied, hardy active sheep of vigorous constitution. Its prolificacy has brought the breed into great prominence, standing, perhaps, ahead of all others in this respect. Both ewes and rams have massive horns which resemble those of a Merino ram, but are larger and not so deeply corrugated.

Head.—Massive, spiral horns, top knot of wool, the face is long and very broad with a rounded bold muzzle and pink nose and lips.

Neck.—Short, thick and fleshy.

Shoulder.—Strong, plenty of depth and good forearm.

Chest.—Broad and deep, a prominent brisket, denoting plenty of heart room.

Back.—Long, broad and fleshy with good loin and well-sprung ribs.

Hindquarters.—The hips are wide and smooth and the rump well developed and rounded.

Legs.—Longer and stouter than those of the Southdown, giving a rather heavy appearance, and are covered with white hair.

Covering.—The wool is rather fine and fairly long in the staple and is chalky white in colour, being free from grey or black straggling fibres. Average counts, 50s.-56s.



# EXPORT FAT LAMB PRODUCTION

## THE FIRST STAGE is the mating of

POOR  
MILKER



SLOW  
MATURING

THE MERINO EWE  
with

HEAVY  
FLEECE



FOR GOOD  
PASTURES AND  
HEAVY LAND

THE LINCOLN  
or

QUICK  
MATURING  
HEAVY BODY  
WEIGHT



HARDY  
SUITABLE  
SCANTY  
PASTURES

THE BORDER-LEICESTER  
or

SHAPELY  
QUICK  
MATURING



FINE WOOL  
FOR GOOD  
PASTURES

THE ENGLISH-LEICESTER  
or

GOOD  
FLEECE



FOR WET  
PASTURES  
RESISTS  
FOOT-ROT

THE ROMNEY MARSH

## POINTS FOR LAMB-RAISERS

Mate the Merino with a Longwool Ram, a Border Leicester, English Leicester or Lincoln in dry districts, and with the Romney Marsh in wet districts to avoid foot-rot.

Mate the Merino Longwool Crossbred Ewe with a Southdown, and if not available, with a Dorset Horn or Shropshire Ram.

Use only Pure-bred Rams and only one breed in each flock.

Mate middle of November so that lambing finishes about end of May.

Feed well especially at mating and after lambing. Guard against overfeeding pregnant Ewes.

Provide ample suitable phosphatic mineral licks for the mothers, especially during the summer. This is most important when the grass is dry.

Give Ewes every assistance at lambing time without undue handling. They should be gone through early morning and late at night.

Grow early feed to reduce hand-feeding as much as possible.

Mark lambs early and at least every three weeks.

Maintain the milk flow by feeding succulent fodders and thus prevent set-backs to the lambs and consequent loss of bloom and profit.

Market direct from mothers in even lots at 70-80 lbs. live weight.

Provide for as little delay in transit as possible. Do not overdrive. Do not catch lambs by the leg or grab the wool. Do not let the dog bite.

MATE EARLY.

FEED WELL.

MARK EARLY AND FREQUENTLY.

MARKET DIRECT FROM MOTHERS  
(before the grass dries off).

MINIMISE DELAY IN TRANSIT.

HANDLE CAREFULLY.

# EXPORT FAT LAMB PRODUCTION

## THE SECOND STAGE is the production of

1st GRADE 28-30 lb.

2nd - 37-42 lb.

3rd - 43-48 lb.

LIVE WT. 70-80 lb.



SHORT BODY

BROAD BACK

THICK FLANKS

THE EXPORT LAMB  
by mating

BIG FRAME

GOOD MILKER



PROLIFIC

PROFITABLE

WOOL PRODUCER

THE LONGWOOL-MERINO X-BRED MOTHER  
with

MATURITY

12 - 14

WEEKS



VIGOROUS

PROLIFIC

THE DORSET HORN  
or

MATURITY

13 - 15

WEEKS



SHAPELY

PROLIFIC

THE SHROPSHIRE  
or

MATURITY

13 - 15

WEEKS



SHAPELY

PROLIFIC

THE SOUTHDOWN





## GRAZING CROPS FOR LAMBING EWES.

### 1. THOMAS, Superintendent of Wheat Farms.

With the decline in wheat and wool prices the prospects of lamb export have become more promising, and, in consequence, the wheat grower will be attracted in this direction.

One of the most important factors connected with the production of export lambs is a supply of succulent feed for the ewes when lambing. If advantage is to be taken of the most favourable period of the market for Western Australia the lambs intended for export should be dropped early in May. Under normal conditions prevailing at this time the natural feed in the Wheat Belt is dry, and may also be scanty, and green feed is not usually plentiful until late in June. These natural disadvantages can be overcome very largely by the growth and cultivation of those fodder crops suitable for our conditions; those adapted to Wheat Belt conditions and suitable for this purpose are oats, barley, and rye, and, to a lesser extent, rape and lucerne. Of these, for Western Australian conditions, oats should undoubtedly be given pride of place, for it is easily grown, is hardy, can be grazed at all stages, and even when it is nearly mature it will make excellent hay; when mature its grain is one of the best concentrates for sheep, cattle and horses. Even the oat stubble, after the grain has been removed, is of value and provides excellent pastures for sheep.

There are many varieties of oats, the best known of which are "Algerian," "Lachlan," "Guyra," "Ruakura," "Mulga," and "Burt's Early." Each of these is of special value under a certain set of conditions, and, for the particular purpose of supplying early grazing for the lambing flock "Mulga" and "Burt's Early" are at the head of the list, followed by the others in the following order, which is also the order of their maturity—"Guyra," "Lachlan," "Ruakura," and "Algerian." All are suitable for grazing, but "Mulga" and "Burt's Early," because of their quick habit of growth, will be fit for grazing a month or six weeks before "Algerian." The growing oat crop can be fed off several times, and then left for hay or to come to maturity for grain. It can be utilised to supplement by grazing the pasture if scanty during the late summer and autumn. Oats can be successfully grown on a variety of soils, from a poor clay or light sandy soil to rich clay or loam. The best results will, however, be obtained on a free-working, well-drained loam.

Barley, like oats, is an excellent early grazing crop. The most suitable early varieties are "Cape" and "Skinless," the former being the hardier. At one time barley, because of its quicker growth than the varieties of oats then in cultivation, was considered superior to oats for early grazing, but since the development of "Mulga" and "Burt's Early" oats it has this advantage no longer. On a wheat farm barley has the disadvantage that the grain from self-sown plants is likely to get mixed with the grain of the succeeding wheat crops, with a resulting "dockage," as millers do not like an admixture of barley with their wheat. Neither is barley nor rye a suitable change crop with wheat, as each is just as subject to "Take-all" as is that plant.

Rye is not nearly as suitable as oats for either hay or grain. It is, however, useful in that it is particularly hardy and grows well on soils altogether too poor for the production of fodder crops of either of the others. It, therefore, has a special value as a grazing crop on sandplain country.

The preparation of the soil is the same for oats, barley, or rye. For crops intended to be used for early grazing it is necessary that the land be fallowed so that they can be planted early to be in readiness for the early rains, and at the same time take advantage of the plant food made available, and also of the stored moisture conserved by the fallowing. The land should be ploughed during the preceding winter, and cultivated to destroy weed growth and maintain a mulch throughout the fallowing period. As the maintenance of the mulch is of the utmost importance, special attention must be paid to this feature of the fallowing process during the summer months. Usually the best implement for maintaining this mulch is a springtyned implement working at a depth of 2 to 2½ inches in the spring and shallower as seeding time is approached. After light rains, working with the harrows will probably be sufficient to restore the mulch. It must be remembered that the harrowed land sets more readily after subsequent showers.

The seed should be sown in the usual way with the seed drill at the rate of 1 bushel per acre, and, for early grazing purposes, at the end of March or the beginning of April. Superphosphate should be applied at the same time, and as liberally as circumstances will permit, say, from 80 to 150 lb. per acre, the higher rates being for the lighter land.

The sheep can be put on the crops at any time after there is sufficient for them to graze, but it is not advisable to pasture the sheep on the cultivated land when very wet.

As a grazing crop Rape has few equals under suitable conditions. It has a high feeding value very similar to Lucerne, is a rapid grower, can be fed off at any time, and, after being fed off, will grow again until the end of spring, when it comes into flower. A good crop will carry 10 ewes and their lambs to the acre, and fatten the latter to prime condition. In the early summer it is subject to aphid attack when, because of the smell, it becomes objectionable, though sheep will eat it readily. It will grow on a variety of soils, but on the lighter soils, particularly if unfallowed, it is apt to be dwarfed and unsatisfactory. It is not very drought resistant, and in many parts of this State it has not proved a very reliable crop. It is, therefore, advisable to sow it with oats so that, if the rape fails, the growth of the oats will ensure that the prepared land will not be wasted. In this State an early autumn start is essential, and this necessitates fallowing and early sowing in March. From 3 to 4 lb. per acre is quite sufficient when sown alone. When sown with oats 1½ lb. is suggested with 20 to 30 lb. of oats. Superphosphate at the usual rate should be applied.

When mixed with oats, rape can be sown through the seed box of the ordinary wheat drill, but when sown alone this is impossible without special seed cups, owing to the small size of the seed. In the absence of these special cups it can be mixed and sown with the superphosphate. The mixing should not be done for longer than 24 hours prior to sowing.

There is some danger of the stock becoming bloated when first turned on to rape. This risk is lessened when mixed with oats, and to lessen it, it is also the practice to mix white mustard with the rape seed in the proportion of 1 to 4. It is advisable to accustom the stock gradually to this crop, and never to put them on it for the first few times when hungry and empty.

Lucerne, except in the extreme Southern part, cannot be grown readily and successfully other than in favoured locations. Because of its semi-permanent character once established it is always ready to take advantage of every shower and provide green picking or luxuriant grazing or hay according to the extent

of the rain. Because of this, coupled with its high feeding value, it is the "Queen of Fodder Plants." Despite its lack of suitability under general conditions it is worth while to search for any special location on the holding to see if, with care, five to 10 acres, or even less, cannot be grown. Briefly, the requirements for success are that the land be well prepared, sometimes in advance of sowing, and freed from weed growth. In its young state weeds are so detrimental to success that the necessity for controlling them will determine when this crop be sown. If the conditions are such that the weeds can be controlled with autumn sowing, then this is preferable, particularly in warm locations. Under cold or wet conditions spring sowing is advisable, and also when the ground is very weedy, as this affords an opportunity for the weed seeds to germinate, and the resulting plant to be destroyed. The rate of seeding for grazing purposes is from  $2\frac{1}{2}$  to 5 lb. per acre, and the depth of sowing about half an inch in the autumn and one inch in the spring. A liberal dressing of superphosphate should be applied at the same time. Those interested in the cultivation of lucerne will find it very fully dealt with in Bulletin No. 149.

The facilities which are available for cultivation on the wheat farm are of great assistance in connection with the production of grazing crops for the lambing ewe. The general farming practice will, however, need to be modified and organised to meet the altered requirements. The area devoted to the growing of wheat for grain will require to be less and the cropping rotation will require to provide for the inclusion of the fodder crops most suitable for particular conditions. It will be an added advantage if the fodder crops are such that, in addition to providing for early green feed for the lambing ewes, they will also help to increase the yield per acre of the wheat crop. Oats and rape are useful in this connection in that these crops are practically immune to the diseases "Take-all" and "Flag Smut," which are present throughout the Wheat Belt, and in some districts have assumed such serious proportions. The only satisfactory control measures for these diseases are those which provide for the starving out of the disease by keeping the ground free of crops susceptible to it. This, however, does not prohibit the planting of such crops as are immune or resistant to them. Crops like oats and rape are immune, and are, therefore, of special value to the wheat grower, in that by their aid the disease is controlled by cropping methods which are profitable and of benefit to the succeeding crop. Barley is not useful in this respect as it is also susceptible to "Take-all" and some other wheat diseases.

Rape has an additional advantage in that it has a strong deep root system which enables it to utilise the plant food in the subsoil, much of which, after the plant above the surface has been fed off, is made available to succeeding crops. Its deep tap root also acts as a natural subsoiler and improves the drainage of the soils in which it is growing.

The growing of grazing crops is, therefore, of benefit to the wheat grower in two ways—they assist him to rear and market his lambs at the most profitable time, and also enable him to control wheat diseases, and thus indirectly produce better yields and reduce costs of production.

## THE EXPORT LAMB.

### THE LESSONS OF THE EXPERIMENTS.

GEO. L. SUTTON,  
Director of Agriculture.

With an enormous unsaleable surplus of Merino sheep, it is inevitable that the agriculturalist, with ability to change the character of his sheep husbandry without serious difficulty, will give consideration to the production of lambs for export, and with decided advantage to his annual income. Though it may require more care than is given to the average Merino flock, probably no branch of the sheep industry furnishes such quick and profitable returns as that of lamb raising. A well-grown lamb four to five months old is frequently worth more than a wether several months older, and the profits from lambs are not unlikely to be greater than those of a whole year from even the most profitable wool types. Lamb raising, too, is eminently suited to the conditions of our agricultural areas, in that it enables the maximum number of stock to be carried during our mild winter, when the feed is most succulent and most abundant, and enables the numbers to be reduced to the minimum when our pastures are driest and scantiest.

In order that the farmers in this State may take the greatest advantage of the facilities which exist for fat lamb export it is essential that our breeders should realise what are the requirements of our customers and satisfy these requirements as well as our conditions will permit. In order to prevent financial loss and waste effort it is also necessary to ascertain and be guided by the information obtained as the result of systematic experiments and gained by hard-won practical experience.

The British market is the only export market of any magnitude open to West Australian lamb raisers. As this market is well supplied, it is imperative that those who desire to obtain satisfactory returns from it must comply with its requirements, even though these latter may be regarded as fastidious. The market of the United Kingdom demands a small lamb—one dressing not more than 42 lbs. and preferably ranging from 28 to 36 lbs. A description of the best export lamb may be set out as follows:—The carcase should be compact and symmetrical, and its general appearance light and bright rather than dark or yellowish; it must also be sappy and fresh and not dry, evenly coated with flesh, but not over fat; the fat should be white and well distributed throughout the body, and showing clearly under the tissues, so that the flesh beneath is more or less completely hidden. Particularly must this be the case on the hind-quarters and points of the withers. This covering of fat is technically known as the "selvedge," and gives to the carcase what is known as the "bloom" or "finish." The body should be well-rounded with a broad back, full in the buttocks, producing a U-shaped arch rather than the V-shaped lankiness. The shoulders and flanks should also be full, with light bone, thick neck and meat down to the knees and hocks.

These characteristics resemble those of the best British mutton breeds, of which the Southdown is probably the leading type. The Merino, valuable as it has been to Australia, cannot conform to these requirements. Its shape is too angular and its meat too dark.

Definite information regarding the unsuitability of the Merino for export purposes is furnished by the experiments conducted at the Roseworthy Agricultural College,\* Gawler, South Australia. These showed that not only did such a lamb mature too slowly, but that 18.33 per cent. failed to reach even the third-quality standard for the export lamb. Of those which reached the export standard, 40 per cent. were classed as third-quality grade; 33½ per cent. as second-quality only, and 8.34 per cent. as first-quality.

Unsatisfactory, however, as is the Merino lamb, obviously the Merino ewe, because it is the sheep of Australia, must of necessity be the foundation from which a suitable export lamb will be secured. To achieve this end it must be produced by improving the carcass qualities of the Merino by mating the latter with a ram of one of the British breeds which are at the other end of the scale with regard to quality of carcass. Numerous British breeds have been evolved during the course of time to suit particular districts in Great Britain, and each of these has a special value for a particular district in that country. Many of the breeds have been tried in Australia, and from the results of these trials it is possible to say definitely that the number of breeds necessary for our purposes can be reduced to a selection from amongst seven. These seven breeds are divided into two groups, known respectively as the Longwool group and the Shortwool or Downs group. In the Downs group are the Southdown, Shropshire and Dorset Horn, and the Longwool group includes the Border Leicester, English Leicester, Lincoln, and Romney Marsh. Both groups produce carcasses of excellent quality. The Longwool group is a dual purpose type producing more wool than those of the Downs type.

#### THE FIRST SERIES OF THE EXPERIMENTS.

One series of the Roseworthy experiments, already referred to, and which are informative and comprehensive, furnish valuable information obtained from mating the Merino ewe with rams of the different breeds already mentioned, and also with the Merino ram.

In connection with the management of the Roseworthy College experimental flocks, the investigators state: "No special care beyond what might reasonably be expected to be given to any farm breeding ewes has been bestowed upon the experimental flocks. The same consideration in respect to grazing, change of pasture, and open or close stocking has, as far as human judgment will permit, been shown to all, every effort being made to offer equal opportunities all round. Hand-feeding has not been resorted to in any instance, reliance being placed wholly on field grazing and systematic changing of flocks as frequently as was deemed desirable. At mating time—middle of November—the ewes were drafted into flocks according to the breed of rams to which they were to be bred. Ewes of all kinds due to be mated with the Dorset Horn, for instance, were put together during the tupping season, and in this way each breed was given an equal opportunity of demonstrating its capacity to yield a high percentage of lambs. The sires were young and vigorous, and the proportion used in each flock was approximately one to forty ewes, or 2½ per cent. Prior to lambing the ewes were carefully drafted into their respective breeds, and were regularly tended throughout the yearning period—latter half of April to early June—with a view to rendering timely help to either ewes or lambs in necessitous cases. The rams were introduced towards the end of November and were withdrawn about seven weeks later."

\* "An Investigation into Certain Aspects of Fat Lamb Production on Agricultural Holdings" (1928)—W. J. Colebatch, B.Sc., M.R.V.S., Principal, and R. C. Scott, R.D.A.

The results of the experiment dealing with the first aspect of this problem, viz., the influence of the different rams upon the fertility of the Merino ewes, are set out in Table 1 hereunder. The percentages given of the lambs dropped, tailed and marketed are those of the ewes mated, and not of the ewes present at lambing time; no account is taken of the ewes lost between mating and lambing:—

TABLE 1.  
INFLUENCE OF THE RAM, ON THE FERTILITY OF MERINO EWES, AND ON LAMBING DIFFICULTIES.

Group.	Lambs Dropped.	Lambs lost, lambing difficulties.	Lambs Tailed.	Lambs Marketed.
<i>Longwool group :</i>	%	%	%	%
Lincoln ... ..	102.74	12.66	89.73	85.38
English Leicester ... ..	92.95	7.48	86.00	83.08
Border Leicester ... ..	92.95	4.00	89.23	89.23
Romney Marsh ... ..	83.01	13.76	71.59	67.69
<i>Downs group :</i>				
Dorset Horn ... ..	93.75	16.44	78.34	76.13
Shropshire ... ..	95.11	15.89	80.00	78.69
Southdown ... ..	91.61	9.04	83.33	81.97

Commenting upon these results the investigators state: "Of the rams mated with Merino ewes the Lincoln gave the highest increase and the Romney Marsh the lowest, but the differences in all other classes were comparatively small." . . . . "Under skilful management the losses occurring after the lambs are tailed will, as a rule, be comparatively small, but the mortality figures for the period between lambing and tailing are relatively high, and this will be understood when it is explained that the lambing figures include all lambs born either dead or alive, as well as unborn lambs discovered 'in utero' on post-mortem examination." . . . . "It is interesting to study the influence of the various rams on the rate of mortality in the lambing fields. The heaviest losses occurred when the Merino ewe was mated with the Dorset Horn, the younger ewes finding difficulty in giving birth to lambs inheriting the big shoulders of their sires. To this cause must be attributed the comparatively low production of marketable lambs from the Merino x Dorset Horn cross. Heavy losses at lambing were also experienced when the Merino ewe was crossed with the Shropshire, Romney Marsh and Lincoln rams, the chief cause in these cases being the size, and particularly the breadth of the head. With the Southdown, English Leicester and Border Leicester sires, however, very little trouble ensued."

The results show that, in order to reduce lambing losses when Merino ewes are mated with the under-mentioned breeds, preference should be given in the following order:—

	Lambs lost between lambing and tailing.
	%
Border Leicester ... ..	4.0
English Leicester ... ..	7.48
Southdown ... ..	9.04
Lincoln ... ..	12.66
Romney Marsh ... ..	13.76
Shropshire ... ..	15.89
Dorset Horn ... ..	16.44

## GROWTH AND DEVELOPMENT OF LAMBS.

In considering this phase the investigators state: "It is important to realise that the whole of the lambs marketed from the experimental flocks have been fattened off their mothers. No artificial feeding of any kind was practised, and, consequently, the data submitted has reference only to flocks kept on natural pasture under dry farm conditions." The practice was to take the weight of the newly born lambs and then to conduct fortnightly weighings commencing when the lambs were about 12 weeks old.

As the result of several season's trials, the following average weights were adopted as representing those of newly-born lambs:—

Ewe.				Ram.				Average weight at birth.
								lbs.
Merino	...	...	...	Merino	...	...	...	8
Merino	...	...	...	Longwool ram—	...	...	...	10
				Lincoln	...	...	...	
				English Leicester	...	...	...	
				Border Leicester	...	...	...	
				Romney Marsh	...	...	...	
Merino	...	...	...	Shortwool Ram—	...	...	...	9
				Dorset Horn	...	...	...	8½
				Shropshire	...	...	...	
				Southdown	...	...	...	

The systematic fortnightly weighings were commenced during the first week in August and continued until the final draft of lambs was marketed, but the subsequent weighings after the period of 14 weeks had elapsed applied to dwindling numbers according to the rate at which they were drafted out for marketing. The table hereunder shows the results of the fortnightly weighing from tailing onwards:—

TABLE 2.

AVERAGE RATE OF INCREASE PER DAY FROM TAILING ONWARDS.

Ewe.		Ram.		Tailing to 12 weeks.	12 weeks to 14 weeks.	14 weeks to 16 weeks.	16 weeks to 18 weeks.	18 weeks to 20 weeks.	Average Increase per day.
				lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Merino	...	Merino	...	0.40	0.48	0.41	0.32	0.19	0.38
Merino	...	Lincoln	...	0.44	0.55	0.58	0.44	0.41	0.47
		English Leicester	...	0.44	0.54	0.59	0.50	0.39	0.47
		Border Leicester	...	0.44	0.47	0.54	0.62	0.43	0.48
		Romney Marsh	...	0.46	0.51	0.48	0.58	0.25	0.46
Merino	...	Dorset Horn	...	0.52	0.53	0.72	0.57	0.20	0.53
		Shropshire	...	0.45	0.51	0.56	0.51	0.33	0.46
		Southdown	...	0.46	0.52	0.57	0.53	0.34	0.48

The details in Table 3 hereunder are interesting in showing the rate at which the lambs of the different crosses were marketed:—

TABLE 3  
RATE OF MATURITY.

Ewe.	Ram.	Percentage Lambs marketed by—							
		Aug. 21st.	Sept. 4th.	Sept. 18th.	Oct., 2nd.	Oct., 16th.	Oct., 30th.	Nov., 13th.	
Merino ...	Merino ...	0·00	14·00	30·00	30·00	40·00	40·00	100·00	
Merino ...	Lincoln ...	3·70	16·67	31·48	33·33	50·00	85·19	100·00	
	English Leicester	0·00	28·30	43·40	58·49	69·81	88·68	100·00	
	Border Leicester	3·23	35·48	53·23	72·58	87·10	95·16	100·00	
	Romney Marsh ...	2·63	26·32	42·11	55·26	76·32	78·95	100·00	
Merino ...	Dorset Horn ...	5·77	59·62	73·08	76·92	94·23	98·08	100·00	
	Shropshire ...	0·00	20·83	35·42	35·42	58·33	79·17	100·00	
	Southdown ...	0·00	24·49	36·73	48·92	77·55	91·84	100·00	

The only outstanding feature of these results is the evidence of the quicker maturing rate of the lambs sired by the Dorset Horn ram, this cross being the quickest to mature followed closely by the Border Leicester. At the middle period of the marketing, viz., October 2nd, the percentage of the total number of lambs marketed was—

Sire.	Percentage lambs marketed middle of marketing period. 2nd October.
Dorset Horn ...	77
Border Leicester ...	73
English Leicester ...	58
Romney Marsh ...	55
Southdown ...	49
Shropshire ...	35
Lincoln ...	33
Merino ...	30

The results are complicated owing to the fact that the lambing was spread over a period of seven weeks. They, however, provide useful data for calculating the age at which lambs of the different breeds can be expected to reach any particular live weight desired.

#### LOSS FROM FARM TO ABATTOIRS.

The Roseworthy Agricultural College is situated comparatively close to the Adelaide saleyards, and stock for sale are not usually trucked until the afternoon of the day preceding the sale. A period of about twenty-four hours—a reasonable one to allow for the time which elapsed—is allowed between the moving and travelling of the lambs to the rail and time of sale, with a shorter period between the



time of sale and slaughter. The losses in the weight of the lambs from the time they left the farm until slaughtered and dressed are set out in the table hereunder:—

TABLE 4.  
LIVE AND CARCASE WEIGHTS OF MERINO AND CROSSED LAMBS.

Sire of lamb.	Farm weight.	Sale-yard weight.	Loss.	Pre-slaughter weight.	Dressed weight.	Shrinkage in dressing.	Loss, farm to hooks.
	lb.	lb.	%	lb.	lb.	%	%
Merino ... ..	80.97	75.87	6.30	73.30	33.07	54.88	59.16
<i>Longwool group—</i>							
Lincoln ... ..	84.62	78.97	6.68	76.77	36.45	52.52	56.93
English Leicester ... ..	84.59	78.96	6.66	77.05	37.74	51.02	55.38
Border Leicester ... ..	82.18	77.96	5.14	76.24	37.19	51.22	54.75
Romney Marsh ... ..	85.85	80.77	5.92	78.36	37.84	51.71	55.92
<i>Downs group—</i>							
Dorset Horn ... ..	81.49	76.90	5.63	74.95	37.38	50.13	54.13
Shropshire ... ..	80.83	75.22	6.94	73.15	35.20	51.88	56.45
Southdown ... ..	78.76	74.14	5.87	72.52	37.27	48.61	52.68

From the above it will be seen that the Southdown cross travelled well and "killed" best, followed closely by the Dorset Horn and Border Leicester in that order. The results are very informative and useful for guidance, but it must be remembered that the actual figures would vary in accordance with the location of the farm and the district in which it is situated. Such factors as distance from the rail, distance of the siding from the export works, weather conditions during loading and transport would affect the actual shrinkage, particularly from farm to sale-yards; though probably the relative shrinkage on dressing between the different crosses would not be affected.

#### QUALITY OF CARCASSES.

The experimental lambs were slaughtered and graded at the Government Produce Depot, Adelaide. The results are shown in Table 5 hereunder:—

TABLE 5.  
QUALITY OF CARCASSES.

Sire.	1st grade.	2nd grade.	3rd grade.	Reject.
	%	%	%	%
Merino ... ..	8.34	33.33	40.00	18.33
<i>Longwool group—</i>				
Lincoln ... ..	50.00	35.19	14.81	...
English Leicester ... ..	77.36	18.87	3.77	...
Border Leicester ... ..	74.19	24.19	1.62	...
Romney Marsh ... ..	31.58	52.63	15.79	...
<i>Downs group—</i>				
Dorset Horn ... ..	63.46	36.54	...	...
Shropshire ... ..	43.75	47.92	8.33	...
Southdown ... ..	91.84	8.16	...	...

The striking feature of these results is the improvement in carcase quality for export purposes which follows as the result of mating the Merino with the British breeds, particularly with the Southdown. The excellent showing of the English Leicester and Border Leicester crosses is also worthy of note.

### THE FINANCIAL RETURNS.

In order to assess the returns obtained from the different crosses, it was decided to base the values upon the prices which had been obtained in London for Australian frozen lamb during the two years previously (1924 and 1925). It was realised that these would fluctuate between fairly wide limits, but, in order to make comparisons, it was essential to fix a definite basis, as the experimental consignments were too small to be sold in separate lots and the actual returns could, therefore, not be used. The following schedule was decided upon after consultation with competent authorities:—

SCALE OF VALUES.

Quality.				Grade.		London price, per lb.	
				No.	Weight in lbs.		
First	...	...	...	2	28-36	s.	d.
Do.	...	...	...	8	37-42	0	10
Do.	...	...	...	4	43 and over	0	8½
Second	...	...	...	2	28-36	0	9½
Do.	...	...	...	8	37-42	0	8½
Do.	...	...	...	4	43 and over	0	8
Third	...	...	...	...	All weights	0	8½
Rejects	...	...	...	...	do.	0	5

Based upon these rates and the percentage of lambs marketed, Table 6 hereunder has been prepared with the different crosses arranged in order according to the calculated return per flock of 100 ewes, and commencing with the cross giving the greatest return:—

TABLE 6.

THE ANNUAL GROSS RETURNS PER 100 EWES FOR EXPORT LAMBS FROM MERINO EWES.

Sire.		Lambs marketed.	Value, Lamb carcasses.		Value, Lamb pelts.		Total Value, Lambs.	
		%	£	s. d.	£	s. d.	£	s. d.
Border Leicester	...	89·23	128	12 10	28	5 1	156	17 11
English Leicester	...	83·08	119	5 6	29	15 6	149	10 11
Lincoln	...	85·38	117	0 10	28	9 2	145	10 0
Southdown	...	81·97	118	3 6	23	4 6	141	8 0
Dorset Horn	...	76·13	108	3 4	22	11 5	130	14 9
Shropshire	...	78·69	107	4 4	23	5 7	130	9 11
Romney Marsh	...	67·69	93	18 5	23	8 2	117	6 7
Merino	...	78·42	84	19 1	28	8 7	113	7 8

It will be seen from these results that of the English mutton breeds under trial the **Border Leicester** proved the most profitable to mate with the Merino. In addition, the results of other phases of this experiment previously given also show that, compared with the other rams mated with the Merino ewe, the **Border Leicester cross**—

**Was freer from lambing troubles;**

**Had the greatest percentage of lambs tailed;**

**In common with others of the Longwool group, produced the lamb of greatest weight at birth;**

**Ranked second to the Dorset Horn in earliness of maturity;**

**Travelled well and "killed" well; and**

**Ranked highly in the production of first-grade carcasses.**

As the climatic conditions which obtain at Roseworthy Agricultural College farm are very similar to those which obtain over a very large portion of the Wheat Belt, these experiments indicate in no uncertain manner that, with the Merino ewe as the mother, the Border Leicester ram should be used as the sire. This is in accord with the practice in New Zealand, where the related English Leicester has been used for mating with the Merino to produce the "Canterbury" lambs, which have earned such an enviable reputation for that Dominion.

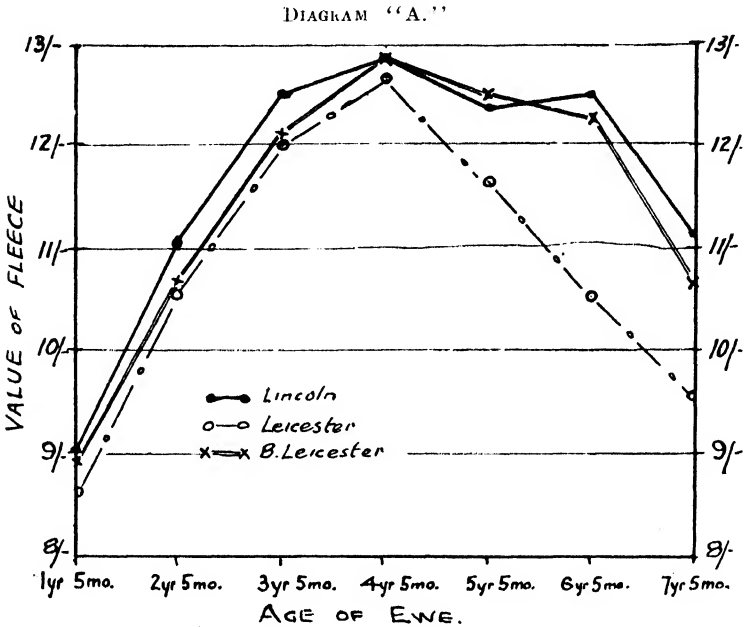
#### THE SECOND SERIES OF THE EXPERIMENTS.

Because of the specialisation in wool which has been practised in Western Australia in common with other parts of Australia, the predominant type of ewe available for lamb production is the Merino, and, in consequence, at present and for some years to come, it is this ewe that will be used. The Merino ewe, however, is not very suitable for the purpose, its progeny is slow-maturing, and, because of this characteristic, the milk supply of the ewe is comparatively light and, though sufficient for its own lamb, is not sufficient to properly satisfy the needs of a vigorous and quickly maturing crossbred lamb sired by one of the British breeds. For this purpose a ewe of a British breed would undoubtedly be the most suitable, but there are not sufficient in Australia to meet the needs of our lamb raisers. Further, it must not be forgotten that the dam of the export lamb has to be carried over the whole year, during which time it is producing a fleece. It is essential, therefore, that it should be a good wool producer. The wool it carries should be of the most valuable kind and the largest quantity possible under the circumstances. Ewes of the Shortwool or Downs type are very much inferior in this respect to the Merino, which stands supreme, and are, therefore, unsuitable.

Though the Merino is essentially the predominant wool type, it is not the only good wool type, and the experiments conducted at Roseworthy in South Australia, and at Bathurst, Cowra and Wagga, in New South Wales, have shown that, as the result of mating British rams of the Longwool type with the Merino, a crossbred sheep is produced from which a very profitable fleece is obtained.

The experiments in New South Wales were conducted at Cowra and Wagga in typical wheat-growing country and similar to that in Western Australia. The breeds experimented with were Lincoln, English Leicester and Border Leicester. The Romney Marsh was not included as the conditions were drier than were considered

suitable to bring out the best characteristics of this breed. With regard to fleece produced, the Lincoln consistently gave heavier fleece weights at all ages from hogget to full-mouth. The value of the fleece was also greater, but only slightly so. These results are graphically shown in Diagram A.



At the Roseworthy Agricultural College the Romney Marsh was included in the experiments with the other three breeds, and comparisons made of the wool return from each cross and also from Merino ewes. The values in each were based upon the following scale of prices, which were the ruling rates on the Adelaide market for farm clips at that time, and were as under:—

Class.	Merino.	Crossbred.
	d.	d.
AA Fleece ... ..	21 1/2	20
A Fleece ... ..	18 1/2	16 1/2
BB Fleece ... ..	17 1/2	16
AA Pieces ... ..	18 1/2	11 1/2
A Pieces ... ..	12 1/2	6
Pieces ... ..	...	3
Bellies ... ..	14	7
Locks and stains ...	3	3

The wool yields of the various crossbred and Merino flocks for the period 1924-26, and the average values calculated on the above scale, are set out in Table 7 hereunder:

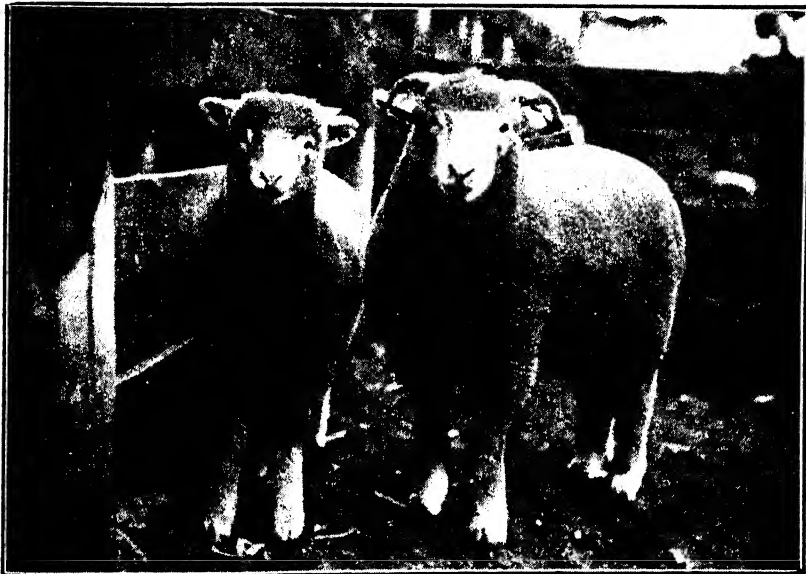
TABLE 7.

WOOL RETURNS FROM MERINO AND LONGWOOL X MERINO EWES.

Ewe.	Number of fleeces.	Average fleece.	Total value.	Average value per head.	Gross Wool returns per 100 Ewes.
		lbs.	£ s. d.	s. d.	£ s. d.
Merino... ..	330	11.00	280 14 4	17 0	85 0 0
Lincoln-Merino ...	94	12.00	69 1 8	14 8	73 6 8
English Leicester-Merino ...	89	10.50	63 16 0	14 4	71 13 4
Border Leicester-Merino ...	92	10.75	64 13 0	14 1	70 8 4
Romney Marsh-Merino ...	89	11.00	63 5 2	14 3	71 5 0

With high prices ruling the monetary returns from the College Merinos were considerably greater than from the crossbreds. With lower rates ruling for all classes of wool the ratio then obtaining (1926) would not obtain now in 1931. Further, it is doubtful whether, under any conditions, the relative financial results would be secured from the average farm Merinos, as ordinarily they are purchased when aged for lamb breeding, and the crossbreds, if not bred on the farm, are purchased when young.

LAMBS FROM MERINO AND LONGWOOL CROSSBRED EWES  
BY THE SAME SIRE,  
"TIPPERARY," 24th AUGUST, 1931.



Sire—Dorset Horn.

Weights 6th August, 1931: Merino Ewe, 47 lbs.; Crossbred Ewe, 83 lbs.

The value of the wool produced by each of the crossbred flocks was of similar value, and, for practical purposes, they may be considered equal in this respect. It is expected this would obtain irrespective of normal variations in the ruling rates for wool. The fact that the Longwool-Merino crossbred is a profitable wool producer gives an added advantage to such crosses in that, should adverse conditions prevent the progeny being sold as lambs, they can be carried over with profit to the hogget stage, or even until older.

Experiments to ascertain the wool returns from the Merino mated with sires of the Downs or Shortwool type were considered unnecessary and unwarranted, as such crosses are known to be unprofitable wool producers.

Though the crossbreds were not as profitable for wool production as the College Merinos, and may not even be as profitable as the average Merino ewe available for lamb production, they were sufficiently profitable to be considered as potential mothers for mating with rams of the Downs type, and were used in a second series of experiments carried out on identical lines to those of the first series already discussed and in which the Merino ewe was the mother.

The influence of the ram used on the fertility of the various Longwool Merino ewes, and on their lambing difficulties, when mated with rams of the different Downs breeds, is shown in Table 8 hereunder:—

TABLE 8.

THE INFLUENCE OF THE RAM ON THE FERTILITY OF THE EWES AND ON LAMBING DIFFICULTIES.

Ram.	Ewe.	Lambs dropped.	Lambs lost, lambing difficulties.	Lambs tailed.	Lambs marketed.
		%	%	%	%
Dorset Horn—Lincoln-Merino		105.00	6.34	98.34	96.72
English	Leicester-				
Merino	... ..	98.86	8.67	90.29	88.71
Border	Leicester-				
Merino	... ..	112.71	2.87	109.48	108.06
Romney Marsh-Merino		100.00	6.33	93.67	90.32
Merino...	... ..	93.75	16.44	78.34	76.13
Shropshire—Lincoln-Merino	... ..	96.89	3.45	93.55	93.44
English	Leicester				
Merino	... ..	85.11	5.75	80.22	75.49
Border	Leicester-				
Merino	... ..	107.80	4.29	103.18	100.00
Romney Marsh-Merino		85.00	11.76	75.00	73.85
Merino	... ..	95.11	15.89	80.00	78.69
Southdown—Lincoln-Merino	... ..	98.44	1.69	96.78	95.16
English	Leicester-	106.67	3.07	103.39	98.36
Merino	... ..				
Border	Leicester-				
Merino	... ..	112.56	3.80	108.28	108.20
Romney Marsh-Merino		113.18	7.18	105.05	103.28
Merino	... ..	91.61	9.04	83.33	81.97

The effect of using any of the Longwool-Merino mothers is to reduce the extent of the mortality found when Merino ewes are used. The Border Leicester Merino ewe is undoubtedly the most prolific, and holds a favourable position with regard to freedom from lambing troubles.

The experience at "Koobabbie," Coorow, supports the results regarding the fertility of the Border Leicester-Merino ewe. This season (1930-31) the number of ewes mated was 1,051, and despite the fact that foxes were prevalent, and an unknown number of lambs taken, the number marked was 1,056 or 100.5 per cent.

It is very generally believed that ewes mated with a Dorset Horn ram are more prolific than those mated with a Southdown or Shropshire. This opinion is, however, not confirmed by the results of the Roseworthy experiments nor by the results with the experimental flocks at Tipperary this season. These latter rather suggest that any difference in the fertility of the ewes is due largely to the individuality of the ram and/or special conditions at time of mating. Dorset Horn, Shropshire and Southdown rams were mated with Longwool-Merino crossbred ewes and also Merino ewes. The ewes were aged and the crossbreds mainly Lincoln-Merino crosses. The ewes were divided into three flocks, each containing 67 crossbreds and 26 Merinos for mating respectively with Dorset Horn, Shropshire and Southdown rams—two rams to each flock of 93 ewes. Between mating and the commencement of lambing 10 ewes died, and as it was impossible to determine to which of the flocks any of these belonged, it was assumed that three from each flock had died, thus reducing the number of ewes to 90 in each. The lambing results are as follow:—

Breed of Ram.				No. of lambs from—		Total.	Percentage.
				Crossbred Ewes.	Merino Ewes.		
Shropshire	...	...	...	51	23	74	82
Southdown	...	...	...	54	18	72	80
Dorset Horn	...	...	...	51	20	71	79

These for experimental purposes are close enough to be regarded as equal.

It will be noted that, in connection with lambing losses, the Dorset Horn shows to the least advantage amongst the rams, and the Romney Marsh-Merino crossbred ewe amongst the ewes. This is in accordance with the experience already recorded when these breeds were mated to Merino ewes. In this connection it must be realised that the Romney Marsh has a special place of its own. As the result of selection over centuries in the marshes of Kent the Romney breed possesses an inherent resistance to footrot, in consequence of which it should be used in wet districts where that disease is troublesome.

## GROWTH AND DEVELOPMENT OF LAMBS.

It was found that the effect of substituting the crossbred for the Merino mother was to increase the weight of the lamb at birth by  $1\frac{1}{2}$  lbs., the relative advantage of the Dorset Horn over the Shropshire and Southdown being maintained, the respective weights of the lambs at birth being—

Ewe.	Sire.		
	Dorset Horn.	Shropshire.	Southdown.
Merino ... ..	lbs. 9	lbs. $8\frac{1}{2}$	lbs. $8\frac{1}{2}$
Lincoln-Merino ... ..	$10\frac{1}{2}$	10	10
English Leicester-Merino ... ..			
Border Leicester-Merino ... ..			
Romney Marsh-Merino ... ..			

The results of the periodical weighings are set out in Table 9 hereunder:—

TABLE 9.

THE AVERAGE RATE OF INCREASE PER DAY FROM TAILING ONWARDS.

Ram.	Ewe.	Tailing to 12 weeks.	12 weeks to 14 weeks.	14 weeks to 16 weeks.	16 weeks to 18 weeks.	18 weeks to 20 weeks.	Average increase per day.
Dorset Horn	Lincoln-Merino ...	lbs. 0.54	lbs. 0.67	lbs. 0.69	lbs. 0.60	lbs. 0.46	lbs. 0.57
	English Leicester-Merino...	0.59	0.67	0.65	0.62	0.49	0.60
	Border Leicester-Merino...	0.59	0.64	0.72	0.54	0.35	0.58
	Romney Marsh-Merino...	0.54	0.65	0.72	0.48	0.31	0.54
	Merino ... ..	0.52	0.53	0.72	0.57	0.30	0.53
Shropshire ...	Lincoln-Merino ...	0.47	0.70	0.56	0.49	0.41	0.51
	English Leicester-Merino...	0.49	0.60	0.67	0.59	0.39	0.53
	Border Leicester-Merino...	0.53	0.63	0.66	0.52	0.43	0.56
	Romney Marsh-Merino...	0.51	0.56	0.64	0.50	0.34	0.51
	Merino ... ..	0.45	0.51	0.56	0.51	0.33	0.46
Southdown ...	Lincoln-Merino ...	0.44	0.64	0.56	0.52	0.38	0.48
	English Leicester-Merino...	0.49	0.76	0.66	0.49	0.41	0.54
	Border Leicester-Merino...	0.52	0.61	0.68	0.51	0.42	0.54
	Romney Marsh-Merino...	0.53	0.58	0.63	0.47	0.35	0.52
	Merino ... ..	0.46	0.52	0.57	0.53	0.34	0.48



It will be seen that the lambs with the Crossbred mothers generally make a decidedly better daily gain than those with Merino mothers, and, in consequence, they will be ready for the market earlier. This is reflected in Table 10 hereunder:—

TABLE 10.  
DATE OF MATURITY.

Ram.	Ewe.	Percentage of Lambs marketed by—						
		Aug. 21st.	Sept., 4th.	Sept., 18th.	Oct., 2nd.	Oct., 16th.	Oct., 30th.	Nov., 13th.
Dorset Horn	Lincoln-Merino ...	22·03	54·24	72·88	81·36	96·61	100·00	100·00
	English Leicester-Merino... ..	30·91	80·00	89·09	89·08	98·18	98·18	100·00
	Border Leicester-Merino... ..	28·36	76·12	85·07	91·04	98·51	98·51	100·00
	Romney Marsh-Merino... ..	19·64	55·36	71·43	80·36	92·86	98·21	100·00
	Merino ... ..	5·77	59·62	73·08	76·92	94·23	98·08	100·00
Shropshire ...	Lincoln-Merino ...	8·77	22·81	49·12	56·14	75·41	80·70	100·00
	English Leicester-Merino... ..	11·63	27·91	48·84	62·79	83·72	95·35	100·00
	Border Leicester-Merino... ..	6·56	40·98	62·30	77·05	93·44	93·44	100·00
	Romney Marsh-Merino... ..	14·29	38·10	57·14	66·67	85·71	88·10	100·00
	Merino ... ..	0·00	20·83	35·42	35·42	58·33	79·17	100·00
Southdown	Lincoln-Merino ...	8·20	19·67	39·34	47·54	75·41	83·61	100·00
	English Leicester-Merino... ..	5·00	20·00	40·00	50·00	78·33	88·33	100·00
	Border Leicester-Merino... ..	1·52	31·82	56·06	77·27	90·91	96·97	100·00
	Romney Marsh-Merino... ..	15·87	46·03	57·14	63·49	84·13	87·30	100·00
	Merino ... ..	0·00	24·49	36·73	48·92	77·55	91·84	100·00

From a comparison of these results it will be seen that the effect of using a crossbred ewe is to expedite the date of marketing by from a fortnight to three weeks. On October 2nd—the middle of the marketing period—77 per cent. of the Dorset Horn-Merino lambs were ready for market, whilst a fortnight earlier 85 per cent. of the Dorset Horn-Border Leicester-Merino lambs were ready. On the same date 35 per cent. of the Shropshire-Merino cross were ready, but four weeks earlier 41 per cent. of the Shropshire-Border Leicester-Merino cross were ready. Similarly, there were 49 per cent. of the Southdown-Merinos ready, and a fortnight earlier 56 per cent. of the Southdown-Border Leicester-Merinos were ready.

Taking the middle of the marketing period again it will be seen that the greatest percentage of lambs was marketed from Border Leicester-Merino ewes, irrespective of what ram was used. The precocity of the Border Leicester-Merino ewe is explained by the results of the New South Wales experiments at Cowra and Wagga from 1909 onwards. The results were consistent and conclusive in showing that

lambs from Merino ewes and sired by the Border Leicester rams were always heavier than lambs and sheep of the same age from similar ewes sired by either Lincoln or English Leicester rams.

The Dorset Horn, as with the Merino ewes, was again the most precocious, and when mated with the Border Leicester-Merino produced 91 per cent. by the middle of the marketing period, compared with 77 per cent. for the Shropshire and Southdown.

Further evidence regarding the earliness of maturity due to the use of the Longwool crossbred ewe, and also of the Dorset ram, is furnished by the experience of Mr. S. B. Rudduck, of "Koobabbie," Coorow, and the experiments carried out on the property of Mr. W. G. Burges, "Tipperary," Burges Siding. Mr. Rudduck finds that his Dorset Horn-Border Leicester-Merino lambs are ready for market about a fortnight earlier than lambs by Southdown rams from ewes of the same cross.

LAMBS FROM MERINO AND LONGWOOL CROSSBRED EWES  
BY THE SAME SIRE,  
"TIPPERARY," 24th AUGUST, 1931.



Sire—Southdown.

Weights 6th August, 1931: Merino Ewe, 53 lbs.; Crossbred Ewe, 80 lbs.

When the first seasonal batch of experimental lambs was being selected for marketing at "Tipperary" on 24th August of this year, it was found that, of the progeny of Merino ewes mated respectively with Dorset Horn, Shropshire and Southdown rams, only two lambs by Dorset Horn rams were of marketable size, whereas 76 lambs from Longwool-Merino ewes were ready and despatched. The

numbers of these and the percentage of the total lambs of each breed are as follow:—

" TIPPERARY " LAMBS, 1931.

Ewe.	Ram.	Number ready for market.	Percentage.
Longwool-Merino ...	Dorset Horn ... ..	37	72.5
Do. ... ..	Southdown ... ..	21	38.8
Do. ... ..	Shropshire ... ..	18	35.2
Merino ... ..	Dorset Horn ... ..	2	10.0
Do. ... ..	Southdown ... ..	Nil	...
	Shropshire ... ..		
	Total ... ..	78	44.3

The relative development of the progeny of the Merino and Longwool cross-bred lamb by the same ram may be readily seen from the illustrations herewith.

It has been the practice to consider that Shropshire crosses would mature more quickly than the Southdown crosses. This view, however, is not supported by the Roseworthy experiments nor by the results this season from the experimental flocks at "Tipperary."

LOSS FROM FARM TO ABATTOIRS.

These losses are shown in Table 11 hereunder:—

TABLE 11.  
MARKETING WEIGHT OF LAMBS Sired BY DOWNS RAMS FROM LONGWOOL MERINO EWES.

Ram.	Ewe.	Farm weight.	Sale-yard weight.	Loss per cent.	Pre-slaughter weight.	Dressed weight.	Shrinkage in dressing.	Loss, farm to hooks.
		lb.	lb.	%	lb.	lb.	%	%
Dorset Horn	Lincoln-Merino ...	85.42	80.31	5.98	78.67	39.08	50.32	54.25
	English Leicester-Merino... ..	81.86	76.95	6.00	75.01	38.12	49.18	53.43
	Border Leicester-Merino... ..	85.46	80.14	6.23	78.52	39.59	49.58	53.67
	Romney Marsh-Merino... ..	84.79	79.81	5.87	77.93	39.29	49.58	53.66
	Merino ... ..	81.49	76.90	5.63	74.95	37.28	50.13	54.13
Shropshire ...	Lincoln-Merino ...	83.24	77.10	7.38	75.18	36.80	51.05	55.79
	English Leicester-Merino... ..	81.70	75.94	7.05	74.31	36.57	50.79	55.24
	Border Leicester-Merino... ..	83.77	78.55	6.23	76.24	38.10	50.03	54.52
	Romney Marsh-Merino... ..	83.68	78.16	6.60	76.23	35.40	53.56	57.70
	Merino ... ..	80.83	75.22	6.94	73.15	35.20	51.88	56.45
Southdown...	Lincoln-Merino ...	80.16	75.26	6.11	73.72	36.98	49.84	53.87
	English Leicester-Merino... ..	80.11	75.13	6.22	73.63	37.62	48.91	53.04
	Border Leicester-Merino... ..	82.73	78.18	5.50	76.28	39.27	48.52	57.70
	Romney Marsh-Merino... ..	81.52	76.73	5.88	75.17	37.88	49.61	53.53
	Merino ... ..	78.76	74.14	5.87	72.52	37.27	48.61	52.68

It will be seen that the lambs from the crossbred mothers travel and "kill" just as well, and in most cases, slightly better than those from Merino mothers by the same sires. It will also be seen that there is less shrinkage with the progeny of the Southdown than with the progeny of any of the other Downs breeds, and from this, and the previous information relative to maturity, it is possible to calculate the approximate relative times necessary for the production of export lambs of a given carcase weight, say, 32 lbs., by Downs sires and from Merino and Border Leicester ewes. The result of these calculations is set out in Table 12 hereunder:—

TABLE 12.

COMPARISON OF WEIGHTS AND AGES IN REACHING MARKET CONDITION.

Lamb.				Dressed weight on hooks.	Live weight on farm.	Weight at birth.	Average weekly gain.	Age in weeks.
				lb.	lb.	lb.	lb.	
Merino	...	...	...	32	78	8.0	3.3	21
Southdown-Merino	...	...	...	32	68	8.5	3.8	15½
Shropshire-Merino	...	...	...	32	73	8.5	3.8	17
Dorset Horn-Merino	...	...	...	32	70	9.0	4.2	14½
Southdown-Border Leicester	...	...	...	32	67	10.0	4.2	13½
Shropshire-Border Leicester	...	...	...	32	70	10.0	4.3	14
Dorset Horn-Border Leicester	...	...	...	32	69	10.5	4.9	12

The results of the grading of the Southdown lambs marketed on 16th September, 1931, from the "Tipperary" and Avondale Experiment Farm experimental flocks are hereunder and show the superiority of the Longwool-Merino crossbred ewe to the Merino as the mother of the export lamb.

QUALITY OF CARCASSES.

Ram.	Ewe.	No. of Lambs.	Percentage of Carcasses.			
			1st Grade.	2nd Grade.	3rd Grade.	Reject.
			%	%	%	%
" Tipperary "—						
Southdown ...	Longwool Merino ...	33	78·8	21·2	...	...
Do. ...	Merino ... ..	18	66·7	16·7	11·1	5·5
Avondale Farm—						
Southdown ...	Border Leicester-Merino	4	100	...	...	...
Do. ...	Merino ... ..	4	75·0	25·0	...	...

In both cases the highest percentage of first-quality lambs was obtained from the Longwool crossbred ewe. It was also noticed, from an examination of the lambs prior to slaughter, that the progeny of the crossbred ewes were broader in the back, thicker in the flanks and shoulders and in every way were more in accordance with the requirements of the export market.

The result of grading the dressed carcasses for quality is shown in Table 13 hereunder:—

TABLE 13.  
QUALITY OF CARCASSES.

Ram.	Ewe.	First Grade.	Second Grade.	Third Grade.	Reject.
		%	%	%	%
Dorset Horn ...	Lincoln-Merino ...	66.10	30.51	3.39	0.00
	English Leicester-Merino ...	76.36	23.64	0.00	0.00
	Border Leicester-Merino ...	58.21	31.34	8.96	1.49
	Romney Marsh-Merino ...	76.79	19.64	3.57	0.00
	Merino ...	63.46	36.54	0.00	0.00
Shropshire ...	Lincoln-Merino ...	54.39	42.11	3.50	0.00
	English Leicester-Merino ...	81.40	16.28	2.32	0.00
	Border Leicester-Merino ...	59.02	37.70	3.28	0.00
	Romney Marsh-Merino ...	57.14	33.33	9.53	0.00
	Merino ...	43.75	47.92	8.33	0.00
Southdown ...	Lincoln-Merino ...	88.52	8.20	3.28	0.00
	English Leicester-Merino ...	90.00	8.33	1.67	0.00
	Border Leicester-Merino ...	84.85	13.64	1.51	0.00
	Romney Marsh-Merino ...	84.13	14.29	1.58	0.00
	Merino ...	91.84	8.16	0.00	0.00

It will be seen from the above that, except in the case of the Southdown, there is a very distinct improvement in quality as the result of the use of the Longwool-Merino crossbred ewe instead of the Merino, and this applies to all breeds of the Longwool group. In both cases the Southdown ram produced the greatest number of first-grade carcasses.

Having regard to the results with both types of ewe the investigators\* write: "The Southdown ram is by far the best sire to use for export lamb breeding, if the object in view is the production of nicely-turned, even-fleshed and uniform carcasses."

The recent (24/8/31) consignment of experimental lambs from Mr. W. G. Burges, "Tipperary," is in agreement with this. The mothers of these lambs were Longwool-Merino crossbreds, principally Lincoln-Merino. The carcasses by the different rams were graded as follows:—

QUALITY OF "TIPPERARY" LAMBS, 1931.

Quality.	Mark.	Weight.	Sires.		
			South-down.	Shrop-shire.	Dorset Horn.
First ...	Swan ...	Under 36	17	...	...
Do. ...	do. ...	.. 42	4	...	...
Do. ...	Cygnat ...	.. 36	...	11	17
Do. ...	do. ...	.. 42	...	5	9
Second ...	Curlew ...	.. 36	...	2	7
Do. ...	do. ...	.. 42	...	...	3
Third ...	...	...	...	...	1
Total ...		...	21	18	37

\* Messrs. Colebatch and Scott.

Though the best quality of the other crosses was classed as first-grade, it was very evident that the Southdown lambs were superior because of their greater plumpness, better "primeness" or "finish" and uniformity.

The monetary returns from the different crosses at the Roseworthy Agricultural College, calculated on the basis of a flock of 100 breeding ewes, are given in Table 14 hereunder. For comparison those of lambs by the same sires but from Merino ewes are included—

TABLE 14.  
ANNUAL GROSS RETURNS FROM 100 EWES (EXPORT).

Ram.	Ewe.	Lambs Mar- keted.	Value, Lamb Carcase.	Value, Lamb Pelts.	Total, Value Lambs.	Value, Ewe Fleece.	Total Return.
Dorset Horn ...	Lincoln-Merino ...	96.72	£ s. d. 139 0 8	£ s. d. 27 0 0	£ s. d. 166 0 8	£ s. d. 73 6 8	£ s. d. 239 7 4
	English Leicester-Merino ...	88.71	127 17 10	24 0 6	151 18 4	71 13 4	223 11 8
	Border Leicester-Merino ...	108.06	155 15 9	29 14 4	185 10 1	70 8 4	255 18 5
	Romney Marsh-Merino ...	90.32	132 9 5	27 9 5	159 18 10	71 5 0	231 3 10
	Merino ...	76.13	108 3 4	22 11 5	130 14 9	85 0 0	215 14 9
	Merino ...						
Shropshire ...	Lincoln-Merino ...	93.44	128 9 7	25 13 11	154 3 6	73 6 8	227 10 2
	English Leicester-Merino ...	75.49	106 18 11	20 15 2	127 14 1	71 13 4	199 7 5
	Border Leicester-Merino ...	100.00	142 1 8	28 6 8	170 8 4	70 8 4	240 16 8
	Romney Marsh-Merino ...	73.85	103 13 11	22 3 1	125 17 0	71 5 0	197 2 0
	Merino ...	78.69	107 4 4	23 5 7	130 9 11	85 0 0	215 9 11
	Merino ...						
Southdown ...	Lincoln-Merino ...	95.16	134 16 2	25 15 5	160 11 7	73 6 8	233 18 3
	English Leicester-Merino ...	98.36	142 12 5	27 1 0	169 13 5	71 13 4	241 6 9
	Border Leicester-Merino ...	108.20	159 2 11	29 15 1	188 18 0	70 8 4	259 6 1
	Romney Marsh-Merino ...	103.28	149 6 6	29 5 3	178 11 9	71 5 0	249 16 9
	Merino ...	81.97	118 3 6	23 4 6	141 8 0	85 0 0	226 8 0
	Merino ...						

The highest monetary returns were obtained by lambs sired by the Southdown ram from Border Leicester ewes, closely followed by Dorset Horn lambs from similar ewes. When the returns from lambs and pelts are compared, it is seen how much better (except in two cases (Shropshire-English Leicester-Merino and Shropshire-Romney Marsh-Merino) are the returns from the Longwool crossbred ewes than from the Merino ewes. To have been otherwise would have been surprising, for, as the experimental results have been examined phase by phase, it has been seen how much better mothers of the lusty, vigorous export lamb are the crossbred ewes than the Merino ewes. It has been shown that—

**They are more prolific;**

**Are freer from lambing troubles;**

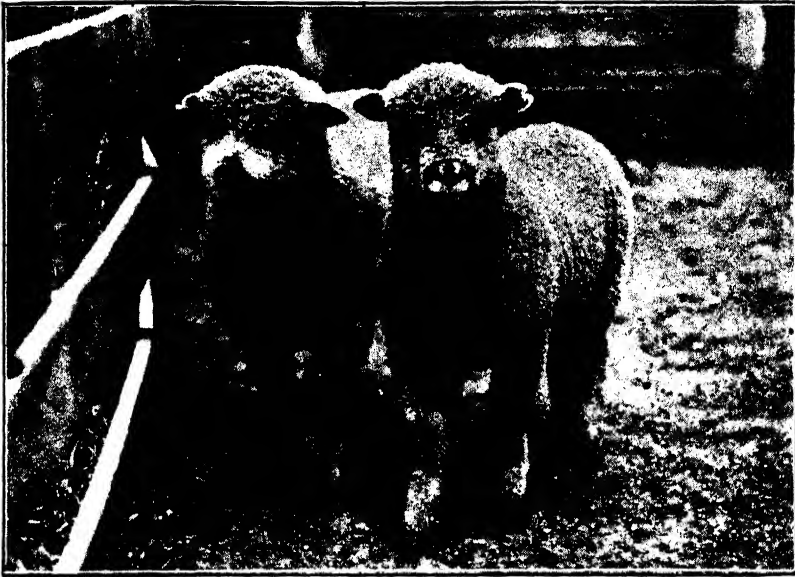
**Produce lambs 1½ lbs. heavier at birth;**

**Produce quicker maturing lambs; and**

**Produce more highest-grade lambs.**

The relative advantage, due to the greater monetary returns from the lambs with crossbred mothers, is lowered if the value of the wool produced by the mothers is taken into account. In this connection, however, it has already been pointed out that the difference between the relative wool returns from Merino and crossbred may require to be reduced because of altered rates and different conditions obtaining on the average farm.

LAMBS FROM MERINO AND LONGWOOL CROSSBRED EWES  
BY THE SAME SIRE,  
"TIPPERARY," 24th AUGUST, 1931.



Sire—Shropshire.

Weights 6th August, 1931: Merino Ewe, 28 lbs.; Crossbred Ewe, 77 lbs.

The experiments have shown that **all** the Longwool-Merino crossbreds were decidedly better than pure Merinos as mothers of the Export Lamb.

The breeding of the crossbred ewes depends upon the conditions under which they are to be kept. Under Roseworthy conditions the Border Leicester-Merino cross was the most suitable, and, as these conditions are similar to those in the greater portion of our Wheat Belt, that cross will be the most suitable for that area. In the wetter districts the Romney Marsh will undoubtedly have its place because of its immunity to foot-rot. Similarly, where pastures are more plentiful and luscious, the English Leicester and Lincoln will find their places.

**Summed up, these experiments teach us definitely that, for the production of Export Lambs—**

- (1) **The Longwool Merino crossbred ewe is a better and more suitable mother than the Merino ewe;**
- (2) **Under the conditions which obtain in the Wheat Belt the most suitable breed to mate with the Merino to produce this Longwool Merino crossbred mother is the Border Leicester, followed by the English Leicester, Lincoln and Romney Marsh, the last-named for wet districts;**
- (3) **To produce the highest quality Export Lamb the Border Leicester-Merino ewe should be mated with the Southdown ram;**
- (4) **When Longwool Merino crossbred ewes are not available, the best results are obtained by mating the Merino ewe with the Border Leicester ram.**

## TRANSPORT, GRADING, AND MARKETING OF LAMBS FOR EXPORT.

E. H. GOLDING, Controller of Abattoirs.

### Transport.

Having produced the correct type, properly fattened and finished ready for export, too much care cannot be exercised in transporting the lamb from the farm to the freezing works.

As this lamb has furnished up to the export grade, about 70 lbs. live weight or 34-36 lbs. dressed weight, in 12-14 weeks from birth and is full of sap owing to suckling the mother for the whole period, it is easy to imagine that, being so tender, it is very susceptible to being bruised.

Quick transport is essential. If the lamb is subjected to rough handling and too long a time is taken between the farm and the works, in addition to the wastage in weight, which is an economic loss, the sap will dry out and the consequent loss in this direction will not only affect the bloom but the flesh will have a tendency to become coarse. This particular item must not be lost sight of, as the fineness of the grain in the meat is largely responsible for the price realised.

Dogs should never be used in yarding or trucking if it can be avoided. Dogs that are used to working in the paddock may never bite a sheep or lamb, but dogs that are used in the yards and races loading and unloading, owing to the congestion, have a tendency to nip the lambs in the legs and flanks, and every time this is done it can be seen in the dressed carcase and is responsible for quite a number of rejects (solely from this cause). For the same reason sticks should not be used. A piece of empty chaff bag is much better.

Lambs should never be caught by the wool. This will also be reflected in the dressed carcase by a bruise wherever it happens. Whenever it is necessary to catch and handle a lamb in the yards, races or trucks, it is better to place the arm under the neck and body and lift it bodily from the ground or floor than attempt to drag it by the leg or wool.

It must never be forgotten that, after having bred the right lamb, in order to realise the maximum return, right from birth to the slaughtering floor, every factor must be strictly observed, and quite a lot of the work in preparing the lambs for export may go for nothing unless every care is observed between the time the lamb is taken from its mother and reaches the freezers.

### Grading.

The first thing the grower should aim at after having secured the correct ewes and rams is a high uniform standard of quality, so that when the lambs reach the export works there will be as few as possible classed as rejects.

The ideal lamb carcase, properly finished, should be compact, symmetrical, full in the neck, broad in the back and loins, thick shoulders, buttocks and flanks, and meat down to the knees and hocks, covered with a smooth white selvedge of fat sufficient to hide the flesh. This is what is known as the bloom, and is very largely responsible for the general appearance and market value. It sometimes happens that, when a lamb is dressed, the kidney fat and general appearance are a dull yellow. This may be due to some impurities in the feed or other causes, but this carcase is invariably rejected as unfit for export.

A fault that is frequently noticed is the manner in which the lambs' tails are docked. In fact, in the majority of cases more care should be observed. The tail



is cut off between the joints, and the bone is left protruding. This causes the meat to be discoloured all round the end of the tail, and is most unsatisfactory.

The correct way to dock a lamb's tail is, before severing the tail, to draw the skin slightly towards the butt or body, then cut the tail off at the second joint. If the skin has been drawn slightly back before cutting, as soon as the tail has been severed, the skin and flesh will come back and completely cover the bone and heal over it. This leaves a more attractive and finished appearance.

A lamb at 13-14 weeks old, properly nourished and cared for, should weigh approximately 68-70 lbs. live weight on the farm, and, assuming the time taken in transit is not unreasonably long, should show a dressed weight at the freezing works of 35-36 lbs. One consignment of "Koobabbie" Southdown lambs out of Border Leicester-Merino ewes in August of this year was sent to the Metropolitan Market and purchased for export. These lambs travelled 13 miles to the railway station, taking  $1\frac{1}{2}$  days, were railed 175 miles, and, after being 72 hours from the farm to the export works, dressed at an average of  $34\frac{1}{2}$  lbs. The lambs were 12-13 weeks old, and topped the market against lambs several pounds heavier. This speaks particularly well for the Southdown lambs out of the Border Leicester-Merino ewes.

The lambs are graded at the works for both quality and weight. There are four quality grades, viz., 1st, 2nd, 3rd, and rejects. These are determined by the condition and bloom of the carcasses. The weight and grades are as follow:—

28-36 lbs., known in the trade as 2s.

37-42 lbs., known in the trade as 8s.

43 lbs. and over, known in the trade as 4s.

36 lbs. and under of the same quality will invariably return a higher price per pound than heavier weights on the London market, consequently as the 70 lbs. live weight will dress at 35-36 lbs., this is a safe course to adopt in order to secure a uniform consignment.

Another reason is that at this age and weight the ewe is able to thoroughly nourish the lamb, and this is reflected in the bloom when viewing the dressed carcass.

The grower should carefully hand-pick the lambs before leaving the farm for both weight and quality, in order that as few rejects as possible reach the works. It does not pay to ship third grade lambs; they will return a better price on the local market, in addition to discounting the value of the first grade lambs in the consignment.

A consignment of uniform weight and quality is calculated to return a better price than would be the case if the consignment consisted of miscellaneous sizes, even if they are of first quality.

Naturally, it is not always possible to secure a parcel of the ideal lambs, but this suggestion is made in order that growers should aim at a uniform standard of the type that will hold its own with anything we have to compete with in the Overseas market, and nothing else will put Western Australia on the map as a State that can produce lambs equal to the best, and consequently enable the grower to secure the maximum return for his efforts.

### Marketing.

The latest advices from London this season are that small lambs are in most demand, and the Southdown cross is still gaining in popularity.

At present, owing to the small number available for export, the only manner in which the lambs can be marketed is either by sending to the metropolitan markets for sale by auction or consigning to the West Australian Meat Export Works at Robb's Jetty and slaughtered, frozen, shipped to London and sold on the grower's account. It is probably fairly safe to say the latter course is the better, on the assumption that the grower can supply a consignment, large or small, of the correct type and quality. By shipping the surplus lambs it will have a tendency to stabilise the local market and this, naturally, will be in the interests of the whole industry.

As time goes on and the numbers increase, no doubt export buyers will operate all over the State during the season and purchase direct from the farm. While the numbers are so limited there is not sufficient inducement for buyers to operate anywhere but the metropolitan markets.

As an illustration of the improvement in the type and quality of our lambs required, last year two or three of the early shipments that reached London in October and early November realised fairly satisfactory prices, but subsequent shipments did not realise within 2½d. or 3d. per lb. of the prices quoted for New Zealand lambs. The logical conclusion to draw is that the earlier shipments reached the market during that period between the tail end of the New Zealand season and the earlier shipments of the following season. Immediately Western Australian lambs had to compete with other new season's lambs, the prices realised were so low as to be unprofitable.

With such an area of country suitable for production of lambs and such a range in the seasons, say, from July on the Midland line to November in the lower part of the Great Southern and South-Western districts, it is not possible to market all the lambs in London in October and November. Consequently, it is absolutely essential that, in order to secure the most use from the natural pastures and produce lambs under the most economical conditions, growers must concentrate on the production of uniform lambs of the highest quality so that they can compete at any time with the best from other countries. This will necessitate breeding along standardised lines and achieving a reputation for quality and uniformity which New Zealand has obtained for "Canterbury" lambs.

## HORTICULTURAL NOTES.

GEO. W. WICKENS, Superintendent of Horticulture.

Up to the time of writing (12th August) weather conditions have been most favourable for the development of fruit buds on deciduous trees. Good rains since the middle of May have supplied the soil with a generous quantity of moisture without making it boggy, and heavy frosts during June rendered the trees thoroughly dormant comparatively early in the season. In the latter connection this season differs in a marked manner from last, when the winter weather was so mild that many apple trees did not cease growing until the end of June, and there is no doubt delayed dormancy had the effect of causing the trees to bud later than usual in the Spring.

In districts where thrips are liable to appear a delay in blooming, even of only one week's duration, may mean the difference between a good crop and a failure, and those who suffered from the thrips invasion of last October will no doubt have cheerfully borne the icy cold morning's of this year's June, knowing that on the one

hand they would be likely to cause the trees to bloom at normal time, and on the other would tend to delay the appearance of the pest. The apple trees in the Southern districts—Cranbrook, Mount Barker, Albany, Kalgan—where thrips caused a failure of the crop last season, are now abundantly covered with fruit-buds and I would like to again impress on growers there the necessity for thinning the fruit in November and December if a heavy setting takes place. In every year of big crops we see thousands of cases of small fruit, nearly unsaleable, or saleable only at prices which do not pay for marketing, and yet the lesson that "it pays to thin" seems as far off as ever from being learned. I think one reason for this is caused by the alternating crops; if it were possible for two heavy crops to occur in successive years there would be no time for forgetfulness, and thinning would engage the orchardist's attention just as regularly as pruning, cultivation and other essentials in horticultural husbandry do now; but when the heavy year follows the lean year only the latter is remembered on the occasion of the next heavy crop, and the fear that thinning will reduce the yield again becomes an obsession with many growers, and the work is not carried out. It may perhaps be worth while to state once more that judicious thinning *does not* reduce the number of cases of fruit for market, it only reduces the number of individual fruits, and it *does improve* the quality.

Particulars in connection with the export of fruit from Western Australia for year ending 30th June, 1931, showing quantities and destinations, will be of interest to growers, and are as follows:—

EXPORT OF FRESH FRUIT FROM WESTERN AUSTRALIA FOR YEAR ENDING  
30TH JUNE, 1931.

Destination.	Apples.	Pears.	Quinces.	Grapes.	Peaches.	Plums.	Lemons.	Melons.	Oranges.	Total.
	cases.	cases.	cases.	cases.	cases.	cases.	cases.	cases.	cases.	cases.
Colombo ...	7,988	...	...	17,133	...	...	...	...	1,361	26,482
Port Said ...	9,554	...	...	181	...	...	...	...	...	6,735
Batavia ...	6,177	362	...	2,198	23	51	50	...	918	9,780
Sourabaya ...	7,145	212	...	2,785	5	58	25	4	413	10,647
Singapore ...	11,793	576	...	7,081	101	144	190	...	1,923	21,809
London ...	150,204	12,486	27	17,291	1	8	...	1	...	180,017
Bombay ...	106	...	...	350	...	...	...	...	...	456
Glasgow ...	25,218	...	...	...	...	...	...	...	...	25,218
Liverpool ...	13,673	...	...	502	...	...	...	...	...	14,175
Hull ...	1,170	...	...	100	...	...	...	...	...	1,270
Southampton ...	1,933	...	...	204	...	...	...	...	...	2,137
Hamburg ...	147,209	2,785	6	500	...	...	...	...	...	150,090
Stockholm ...	68,687	350	...	500	...	...	...	...	...	69,537
Copenhagen ...	15,392	...	...	50	...	...	...	...	...	15,442
Bremen ...	10,098	...	...	...	...	...	...	...	50	10,148
Dunkirk ...	5,158	...	...	...	...	...	...	...	...	5,158
Durban ...	3,422	...	...	...	...	...	...	...	...	3,422
Mauritius ...	50	...	...	50	...	...	...	...	...	100
Rangoon ...	260	...	...	50	...	...	...	...	25	335
Samarang ...	75	...	...	...	...	...	...	...	...	75
Palembang ...	20	...	...	...	...	...	...	...	...	20
Penang ...	6	...	...	5	...	...	...	...	100	111
Wellington, N.Z. ...	...	...	...	...	...	...	...	...	175	175
Auckland, N.Z. ...	...	...	...	...	...	...	10	...	225	235
Shanghai ...	...	...	...	...	...	...	...	...	100	100
Hong Kong ...	210	...	...	...	...	...	...	...	100	310
Lyttleton, N.Z. ...	...	...	...	...	...	...	...	...	70	70
Dunedin, N.Z. ...	...	...	...	...	...	...	...	...	70	70
Totals ...	482,638	16,773	33	48,480	130	261	275	4	5,530	554,126

It will be noted that apples, grapes and pears, in the order mentioned, are our principal export fruits and the quantity of grapes sent away this year had only once been exceeded. This occurred in 1929, when 48,683 cases were exported, but prices received this year were considerably better than in 1929. Oranges, unfortunately, still rank low in quantity exported—under 6,000 cases out of an annual average production of over 200,000 cases—and it is hoped experiments now being conducted by the Council for Scientific and Industrial Research in treatment before shipment

will prove successful and enable citrus fruits to be landed on the overseas markets in good condition, for the difficulty connected with this has in the past been the principal reason why oranges have not been exported in larger quantities from Western Australia.

A review of particulars of acreage and production for year ending 30th June, 1930 (latest figures available), show that the area under orchards increased by 136 acres, from 18,735 to 18,871, and that the increase was almost wholly due to apple trees, the area under these having risen from 10,468 acres in 1929 to 10,885 in 1930 an increase of 417 acres. The principal decreases in the period mentioned occurred in orange trees—75 acres, and pear trees—72 acres.

The area under vineyards shows a small increase of 21 acres.

Particulars of acreage and production of all kinds of fruit for season 1929-30, are as follow:—

#### FRUIT PRODUCTION AND ACREAGE FOR SEASON 1929-30.

Kinds of Fruit.	Area.			Yield.
	Unproductive acres.	Productive acres.	Total acres.	bushels.
Oranges ... ..	440	2,416	2,856	218,386
Mandarins ... ..	19	161	180	14,102
Lemons ... ..	46	457	503	58,180
Other Citrus Fruits ... ..	8	20	28	3,894
Apples ... ..	3,028	7,857	10,885	442,243
Pears ... ..	122	893	1,015	87,461
Peaches ... ..	174	633	807	65,547
Apricots ... ..	135	553	688	62,193
Nectarines ... ..	56	151	207	15,231
Plums ... ..	240	675	915	70,732
Quinces ... ..	15	80	95	8,287
Figs ... ..	49	301	350	34,950
Bananas and Plantains ... ..	1	7	8	1,684
All other Fruit Trees ... ..	78	200	278	Value £6,656
Strawberries ... ..	...	25	25	42,449 quarts
Other Small Fruits ... ..	...	31	31	Value £492
Totals ... ..	4,411	14,460	18,871	...
<i>Grape Vines.</i>				cwts.
Table Grapes ... ..	...	1,030	1,030	57,995
Wine Grapes ... ..	...	1,338	1,338	46,058
Drying Grapes ... ..	...	2,233	2,233	172,676
Grape Vines not bearing ... ..	363	...	363	...
Totals ... ..	363	4,601	4,964	276,729

It will be noted from the above, that of a total area under orchards of 18,871 acres, 10,885 acres or 57·6 per cent. is comprised of apple trees.

## PLANT PROTECTION AND APICULTURE.

H. WILLOUGHBY LANCE,  
Apiculturist.

The "Bee World" for May, 1931, gives a summary of a broadcast lecture by Professor Dr. Borchert on the above subject, and as plant protection and apiculture are both related to the agricultural wealth of Western Australia as much as to that of any other country, I propose to deal briefly with the subject in these pages.

It is not so long ago that beekeeping was considered by many as the hobby of a few cranks, but if we go further back, we find that it was an important pursuit and means of wealth long before Great Britain became a part of the civilised world. At the present time apiculture is a most important industry in many countries, not only for the production of honey, but also on account of its importance for the efficient fertilisation of fruit-trees and flowers.

Plant protection is not of such ancient date as beekeeping, but is a most important part of present-day agriculture; and its aim, like that of apiculture, is to increase the agricultural wealth of the country. Diseases and pests attacking cultivated trees and plants, and the excessive growth of weeds, are responsible for many crop failures. Plant protection by the use of washes, sprays, dusts, and traps aims at controlling or destroying these pests and thus increasing the yield.

Apiculture has to struggle against the competition of sugar, diseases which attack bees, and the destruction of nectar-bearing trees. To these has been added another danger—that of plant protection. If diseased plants are treated at the wrong time, or in an unsuitable manner, bees as well as pests may be destroyed.

It is to be feared that many orchardists and market gardeners do not realise the importance of the little insect, of which so many persons are afraid, for the success of their industry, and that the bee is really their friend. It is a certain fact that if all bees were destroyed many crops would fall to an unprofitable figure.

The importance of the bee as a pollinating agent is in some countries realised to such an extent that orchardists will pay beekeepers 12s. to 15s. per colony to place their hives in their orchards at blossoming time. This may seem an excessive amount, but if the colonies are strong and in condition for the work, and the orchard conditions are correct, the increased crop much more than compensates for the outlay. In market gardening much the same applies, particularly in the case of pumpkins. Many instances are known where there has been a good flowering of pumpkins, but very little setting of fruit; but in the following year, bees having been introduced, there has been a heavy crop. Bearing these facts in mind, it behoves all those interested in plant protection to insure that when they are destroying pests, they are not also destroying their friends.

The chief danger lies in the fact that the means most convenient for the combating of pests and diseases contain chemical substances such as sulphur, copper, arsenic, fluorine, etc. If these are used in the winter to destroy eggs of pests, or diseases, very little harm results to the bees, as the blossom is not there to attract them; also, many of the sprays and washes used at this season do not contain substances harmful to bees. The most harm is done in the spring and the summer, when the bees are most active and blossom is most plentiful. The danger, however, is not so great if sweet substances, attractive to bees, are not added to the sprays. The greatest care is required in the spring time, when orchards are

in blossom. It is essential that sulphur, copper, or arsenical mixtures are not applied at the time of blossom, as this is certain to result in the destruction of many thousands of bees. The same applies to vegetable gardens.

In America and Germany aeroplanes have been used to distribute poisonous dusts over the forests, to destroy forest pests. Serious damage has resulted to many beekeepers as a result, and in one case in Germany a beekeeper, who lost 353 colonies as a result of this dusting, was fortunate in securing compensation of £370.

Seeing that many apiculturists depend upon beekeeping for a living, and that beekeeping is a most important branch of agriculture owing to the great services rendered by bees, it is only right and in the interests of the persons concerned that measures of plant protection should be carried out in such a way as not to be harmful to bees. Bees are very sensitive to poisons and it is stated that  $2/1,000,000$ ths of a gramme of metallic arsenic,  $9/1,000,000$ ths of copper or  $13/1,000,000$ ths of sodium fluorine is sufficient to kill a bee.

Abundant evidence has been produced by investigators working in all parts of the world, which shows that, other factors being equal, the honey bee is the principal factor in the efficient pollination of fruit trees and many vegetables.

Remember that *More Bees means More Fruit*—see "Pollination of Orchards," *Agricultural Journal*, June, 1930, page 316. In the opinion of many, the honey bee is more valuable to mankind on account of the work it does in the pollination of plants and trees—that produce millions of pounds' worth of food—than for the amount of honey it produces. Beekeeping has, therefore, a double value, not only being profitable to the apiarist himself, but of even greater value to his neighbour.

## SEED AND SEED-BED DISINFECTION.

### FUNDAMENTAL PRINCIPLES OF PLANT DISEASE CONTROL.

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There are many different ways in which parasitic organisms may gain access to a property or field, etc., on which they have not previously occurred. In the case of cereal, vegetable and flower-garden plants, which are typically grown afresh each season from seed, a very common, and often unsuspected, method is by means of the seed itself; using the term in its very widest sense to include such natural vegetative means of propagation as bulbs, corms, tubers, rhizomes and similar plant structures.

The parasitic organisms so introduced may occasionally be visible to the naked eye, as in the case of wheat grains heavily infested at the "brush" end with "bunt" spores (*Tilletia spp.*), or potato tubers affected with "Rhizoctonia Scab" (*Rhizoctonia solani*); but much more frequently they are present, either inside or outside the seeds, in the form of bacterial cells or fungal spores or threads which are quite invisible to the naked eye. Many of them, indeed, may only be detected with difficulty even with microscopic or other laboratory means.

It thus comes about that a sample of seed wheat, which may appear perfectly clean and satisfactory to the unaided vision, may actually be heavily infected

internally with the "loose smut" fungus (*Ustilago tritici*), while a sample of cabbage seed quite healthy to look at may be heavily contaminated with the bacteria responsible for "black rot" (*Pseudomonas campestris*). "Fusarium Wilts" of tomatoes and watermelons, due to *Fusarium lycopersici* and *F. nivum*, respectively, provide other very good examples.

Of recent years there has been a steady increase in this State in the number of seed-borne diseases attacking vegetable- and flower-garden plants, and also in the number of plants affected.

This may be attributed very largely to the almost complete absence of seed-disinfection methods on the part of the vast majority of flower and vegetable-growers. Those few progressive persons who have regarded seed and seed-bed disinfection as routine parts of their crop-production activities, have been repaid for the extra time and trouble many times over. On the other hand, cases have come under the notice of the writer where growers have been practically forced out of business, at least with particular crops, because they have neglected to do so. This has been particularly obvious in the case of "black leg" of cabbages and cauliflowers (*Phoma lingam*), "Fusarium Wilts" of tomatoes, watermelons and "Queensland Blue" pumpkins, and "Black Rot" of cabbages and cauliflowers.

The most fundamental principle of plant disease control, in the case of crops propagated from seed, may be summed up in the phrase, "Plant clean seed or seedlings in clean soil" using the term "clean" as synonymous with "disease-free." This must be followed up, of course, wherever necessary and economically possible, in the case of wind- or insect-disseminated diseases, by spraying with appropriate fungicides or insecticides to keep the so-far clean plants from becoming diseased from external sources of infection.

The above programme involves, logically, the following steps:—

- (1) Seed disinfection, or the use of known disease-free seed.
- (2) Seed-bed disinfection, or the use of known disease-free soil.
- (3) Planting-out, in the case of transplanted crops, into disease-free soil, or alternatively into soil which has not grown the same or closely related susceptible plants for several years—the rotation or rest-period in the interim being always as long as is economically possible.
- (4) Spraying the above-ground parts of the plants, if necessary, to prevent infection from outside sources.
- (5) Eradication, where possible, of any internal or external sources of infection not already covered by (1) and (2).

To these may be added:—

- (6) Manipulation, if possible, of the environmental factors, such as atmospheric humidity (where overhead sprinklers are used, in glasshouses, etc.), soil reaction (acidity or alkalinity, pH), soil moisture relations, or time of the year when the plants are grown, so that even if the disease is present it will do only a minimum of damage.

Better than all these things, of course, where practicable, is the growing of resistant varieties, but unfortunately in very many cases this method is still rather an ideal than a reality.

Table 1 gives a list of the disinfection methods most commonly recommended for cereal, vegetable, and flower-garden seeds. In every case strict attention must be given to detail, so that the disease-producing organisms may be killed, without, at the same time, causing any serious injury to the seed.

TABLE I.  
SUMMARY OF SEED TREATMENTS FOR PREVENTING OR REDUCING SEED-BORNE DISEASES OF VARIOUS CROPS.  
A.—CEREAL CROPS.

Crop.	Disease.	Pathogen.	Disinfectant.	Quantity, Strength or Temperature.	Method of Treatment and Remarks—Further References, Cautions, etc.
Wheat ...	Bunt or Stinking Smut	<i>Tilletia laevis</i> or <i>T. tritici</i>	Copper Carbonate	2-3 ozs. per bushel (dust treatment)	Mix in tightly-closed container until each grain is thoroughly coated with the dust. Do not inhale the dust. Seed may be treated any length of time prior to sowing. (See Leaflet 160).
Do. ...	Flag Smut	<i>Uromyces tritici</i>	do. ...	2-3 ozs. per bushel (dust treatment)	As above. Only useful to prevent infection of clean paddocks by seed carrying "flag smut" spores. Use also the following control measures:—Harvest infected crops for grain, not for hay; burn stubble; fallow early and cleanly; rotate with oats, barley, peas, etc.; then fallow again; then sow wheat shallowly in moist seed bed. Best of all grow resistant varieties on infected paddocks. (See Leaflets 160 and 326).
Do. ...	Loose Smut	<i>Ustilago tritici</i> ...	Hot water	129° F.	Treat seed in sacks only half filled and tied at the top. Soak 4-5 hours in cold water at ordinary temperature; then dip in water at 120° F. for about one minute; then soak 10 minutes at 129° F. Temperature must not exceed 131° F. or fall below 124° F. during treatment. Then plunge into cold water and spread out thinly to dry. Use this seed to plant an isolated seed plot and save all resultant seed to plant following year without further treatment. The best method is to obtain clean seed from Government Farm, or some other clean crop in first place. (See Leaflet 160).
Do. ...	do. ...	do. ...	do. ...	120° F.	Alternatives to above. Treat seed 1 hour 35 minutes at 120° F. in sacks only half filled and tied at top, then plunge in cold water and spread out to dry. See last three sentences of previous paragraph.
Barley ...	Covered Smut	<i>Ustilago hordei</i> ...	Formalin...	1 pint in 40 gallons water	Soak 30 minutes, or alternatively spread grain out on clean floor or tarpaulin and sprinkle with the formalin at strength indicated, turning heap repeatedly with shovel until every grain moistened. This takes about $\frac{1}{2}$ gallon to every bushel of grain. Then cover with bags, etc., moistened with the formalin solution and leave covered for 4-6 hours. Remove covers and spread grain out thinly to dry. Sow as soon as dry enough to run through drill. Plant in moist seed bed or germination may be considerably reduced. (See Leaflet 160).



TABLE I.—continued.  
A.—CEREAL CROPS—continued.

Crop.	Disease.	Pathogen.	Disinfectant.	Quantity, Strength or Temperature.	Method of Treatment and Remarks—Further References, Cautions, etc.
Barley—continued.	Loose Smut	...	Hot water	126° F.	Treat seed in sacks only half filled and tied at the top. Soak 4–5 hours in cold water at ordinary temperature; then dip in water at 120° F. for about 1 minute; then soak 13 minutes at 126° F. Temperature must not exceed 129° F. or fall below 124° F. during the final treatment. Plunge into cold water. Spread out to dry. This treatment kills both "loose" and "covered" smuts of barley. The treatments given under "covered smut" of barley kill some of the "loose smut" at the same time as the "covered smut" but not all.
Oats	Loose and Covered Smuts	<i>Ustilago avenae</i> and <i>U. laevis</i>	Formalin	1 pint in 35 to 40 gallons water	Soak 30 minutes or, alternatively, use sprinkling method as detailed under "covered smut" of barley, leaving heaps covered 6 to 8 hours. In any case spread out grain to dry at end of period and sow as soon as dry enough to run through drill, in moist seed bed. (See Leaflet 160).

B.—VEGETABLE GARDEN PLANTS, ETC.

Cabbage flower	Black Rot	...	Mercuric chloride (Corrosive sublimate)	1 in 1,000	Immerse seed for 30 minutes in the case of cabbage, and 20 minutes for cauliflower. After removing from the solution allow to drain for a minute or two, then rinse for 15 minutes in clean running water. Drain and spread out thinly to dry in cool shady place. See section in text on "Method of using the Diluted Corrosive Sublimate," for fuller details.
Do.	Black Leg	...	Hot water	122° F.	Immerse seed in loose muslin or cheese-cloth bags in water at 122° F. for 30 minutes. Keep bags and water constantly stirred with thermometer. If necessary, add small amount boiling water slowly from time to time to keep up the temperature. At end of time remove, plunge into cold water, drain and spread out thinly in cool shady place to dry. The corrosive sublimate treatment given above is fairly effective against "black leg," but does not kill any fungus threads actually within the seed coat as does the hot water treatment.

TABLE I.—*continued.*  
B.—VEGETABLE GARDEN PLANTS, ETC.—*continued.*

Crop.	Disease.	Pathogen.	Disinfectant.	Quantity, Strength or Temperature.	Method of Treatment and Remarks—Further References, Cautions, etc.
Potato ...	Common scab, Rhizoctonia and Black Leg, etc.	<i>Actinomyces scabies</i> , <i>Rhizoctonia solani</i> , and <i>Bacillus atrocephalus</i> , etc.	Mercuric chloride (corrosive sublimate)	1 in 1,000. 4 ozs. Sublimate to every 25 gallons water. See formula "f" table 11	Soak tubers, uncut and unsprouted, for 11–2 hours. The solution weakens with use, therefore one ounce of dissolved sublimate (1 pint stock solution as per Table 11) should be added to each 25 gallons, after each lot has been treated. Also add any necessary water to bring volume up to the original level each time. An entirely fresh solution should be prepared after treating four lots. Each 25 gallons of solution treats about 5 bushels of tubers. Dip tubers in wooden crates, not bags, or else immerse directly into barrel or vat if provision has been made to drain the solution into another container after the treatment. Effectiveness of the treatment is greatly increased by dipping tubers in water and keeping moist for a day or two before treatment. If this is done soaking period may be reduced to half hour. If tubers are washed to remove dirt before dipping, and are not immersed in the bags, the solution may be used six to eight times before discarding, provided it is strengthened each time as described. (See Leaflet 72)
Do. ...	do. ...	do. ...	(old) Formalin ...	1 pint to 30 gallons water	Soak tubers unsprouted and uncut 11–2 hours. If tubers are moistened before treatment as described above, soaking period may be reduced to half hour and effectiveness increased. (See Leaflet 72). Solution keeps its strength but more solution should be added, as required, to keep up the volume to original level.
Do. ...	do. ...	do. ...	Hot Formalin ...	1 pint to 15 gallons water at 122° F.	Soak tubers, unsprouted and uncut, 3–4 minutes, but no longer. Temperature must be kept between 121° F. and 123° F. during treatment. Then spread out thinly in cool shady place to dry.
Tomato ...	Fusarium wilt ...	<i>Fusarium lycopersici</i> ...	Mercuric chloride (corrosive sublimate)	1 in 3,000 ...	Use formula (a) in Table III., but make up with water to 1 gallon 1½ pints, or use formula (b) of same table, but make up with water to 2 gallons 2½ pints. Treat for 5 minutes, stirring frequently. Wash 15 minutes in clean running water and spread out thinly in cool shady place to dry.
Watermelon and Pumpkin	Fusarium wilt ...	<i>Fusarium nivium</i> ...	Mercuric chloride	1 in 1,000 ...	Treat for 5 to 7 minutes, stirring frequently. Wash in clean running water for 15 minutes, and then spread out in cool shady place to dry.

TABLE I.—*continued*.  
B.—VEGETABLE GARDEN PLANTS, ETC.—*continued*.

Crop.	Disease.	Pathogen.	Disinfectant.	Quantity, Strength or Temperature.	Method of Treatment and Remarks—Further References, Cautions, etc.
Celery ...	Early and Late Blight	<i>Cercospora apii</i> , <i>Septoria apii</i>	Mercuric chloride	1 in 1,000	Treat for 30 minutes as cabbage seed above. Sow while still moist.
Do. ...	do. ...	do. ...	Hot water	118° F.	Treat for 30 minutes as cabbage seed above, but with temperature at 118° F. instead of 122° F. Sow while still moist.
Other Vegetable seeds	Various ...	Various ...	Mercuric chloride	1 in 1,000	Treat for 5 minutes, stirring frequently. Wash 15 minutes in clean running water, and then spread out thinly in cool shady place to dry.
Tobacco ...	Downy Mildew ("Blue Mould")	<i>Peronospora sp.</i>	Alcohol	Absolute	Immerse 5 minutes in muslin bag. Drain one minute or so, spread on clean dry blotting paper in thin layer, turn over several times, and place in cool airy place to dry. This Department will treat at charge of one shilling per ounce, or part thereof.
C.—FLOWER GARDEN PLANTS.					
General Seed Treatment for common diseases of flower-garden plants	Various ...	Various ...	Mercuric chloride (or rose sublimiate)	1 in 1,000	Immerse seeds with thin seed coats or which absorb moisture readily for 5 minutes only with frequent stirring. Most other flower garden seeds can be immersed for 15–30 minutes without injury. Rinse in clean running water for 15 minutes after treatment, and spread out in cool shady place to dry, or sow while still moist.
Gladiolus ...	Bacterial Scab, <i>Septoria</i> , Hard Rot, etc.	<i>Bacterium rottingum</i> , <i>Septoria gladioli</i> , etc.	Mercuric chloride	1 in 1,000	Soak unsprouted corns for 2 to 4 hours. Allow to drain and spread out thinly in cool shady place to dry.
Do. ...	do. ...	do. ...	Organic Mercury compounds such as "Squibsan"	...	Use as recommended by the manufacturers.

## ACKNOWLEDGMENT.

The writing of this article and the preparation of Table I has been inspired by the United States Department of Agriculture Miscellaneous Publication, No. 94, "Seed Treatment Reduces Losses from Plant Diseases," by F. C. Meier, Principal Pathologist in Charge, Office of Barberry Eradication, U. S. D. A., Bureau of Plant Industry, the assistance of which is hereby gratefully acknowledged.

## PREPARATION OF CORROSIVE SUBLIMATE FOR SEED DISINFECTION.

*Stock Solutions Recommended.*

Corrosive sublimate (mercuric chloride) is the chemical most commonly used for the disinfection of vegetable- and flower-garden seeds, the most frequently used formula being that known as "1 in 1,000." This means 1 part by weight of Corrosive Sublimate (Mercuric Chloride) to 1,000 parts by weight of water. In publications originating in the United States of America, the directions for making up this "1 in 1,000" strength, are to dissolve the Corrosive Sublimate at the rate of 1 ounce in 7½ gallons of water. In British countries, however, the gallon measure used is larger than that used in the U.S.A., so that *the correct formula where using the Imperial gallon as a measure of volume is at the rate of corrosive sublimate 1 ounce avoirdupois in 6½ Imperial gallons of water.*

Where large quantities of Corrosive Sublimate solution are required, as in the disinfection of potato tubers or gladiolus corms, *the most convenient method of preparation is to make up a stock solution at the rate of one pound of finely-powdered sublimate in two gallons of hot water.* The poison may be dissolved by carefully pouring the hot water over it in the bottom of a wooden, earthenware, glass or enamelled vessel. After cooling, the solution should be stored in a tightly-stoppered, clearly-labelled, glass or earthenware jar, etc., under lock and key, till required. Metal containers must never be used for Corrosive Sublimate solutions, as they are corroded by the disinfectant. The chemical only dissolves very slowly in cold water, so that hot water should be used whenever possible in making up the stock solutions.

TABLE II.

DILUTION TABLE FOR MAKING 1 IN 1,000 CORROSIVE SUBLIMATE SOLUTION, USING A STOCK SOLUTION OF ONE LB. CORROSIVE SUBLIMATE IN TWO GALLONS OF WATER (OR HALF LB. IN ONE GALLON).

Stock Solution. Take amount indicated below.	Amount of dissolved sublimate in quantity of stock solution taken.	Dilute with clean cold water in wooden, glass, cement or earthenware container to final volume indicated below.
(a) ½ pint	1 ounce	1 gallon 4½ pints
(b) ¼ " "	½ " "	3 gallons 1 pint
(c) ⅓ " "	⅓ " "	4 " 5½ pints
(d) 1 " "	1 " "	6 " 2 " "
(e) 1 quart	2 ounces	12 " 4 " "
(f) ½ gallon	4 " "	25 " "
(g) 1 " "	8 " "	50 " "
(h) 2 gallons	1lb. "	100 " "

In cases where it is anticipated that only very little of the disinfectant will be required, a more convenient stock solution may be prepared by dissolving ½ ounce of Sublimate in 1 quart of hot water (or 2 ounces in one gallon) by the same method as indicated above. For use this second stock solution is diluted as follows:—

TABLE III.

DILUTION TABLE FOR MAKING 1 IN 1,000 CORROSIVE SUBLIMATE, USING A STOCK SOLUTION OF ONE HALF OUNCE (½oz.) IN ONE QUART OF WATER (OR TWO OUNCES IN ONE GALLON.)

Stock Solution. Take amount indicated below.	Amount of dissolved sublimate in quantity of stock solution taken.	Dilute with clean, cold water in wooden, glass, cement or earthenware container to final volume indicated below.
(a) ½ pint	1/16th ounce	3½ pints
(b) ¼ " "	1/8th " "	6½ " "
(c) ⅓ " "	3/16ths " "	1 gallon 1½ pints
(d) 1 " "	¼ " "	1 " 4½ " "
(e) 1½ pints	3/8ths " "	2 gallons 2½ " "
(f) 1 quart	½ " "	3 " 1 " "
(g) ½ gallon	1 " "	6 " 2 " "
(h) 1 " "	2 ounces	12½ " "

The strengths of all stock solutions should be written on the labels as soon as the solutions are prepared, and it would be just as well also to include a copy of the appropriate dilution table on the same or a separate label on the container.

**Mercuric Chloride (Corrosive Sublimate)** is deadly poisonous to human, animal or plant life. In addition, it is colourless, odourless, and comparatively tasteless, and may easily be mistaken in solution for pure water. It should, therefore, be used with great care and kept out of the reach of children or farm stock. When finished with, the solution should be poured into a hole in the ground, and the hole be immediately filled in or covered over. In case of mercuric chloride poisoning give whites and yolks of eggs mixed with milk. In emergency, ordinary flour paste may be used. Then give a mustard emetic to induce vomiting and send immediately for medical assistance.

#### METHOD OF USING THE DILUTED CORROSIVE SUBLIMATE FOR DISINFECTING SEEDS.

The seeds are best immersed in the dilute Corrosive Sublimate in a cheese-cloth or muslin bag of such a fineness of weave that the seeds being disinfected will not fall through the meshes of the material. The bag should be kept constantly agitated in the solution so as to remove air bubbles, which otherwise tend to prevent intimate contact between the solution and portions of the seed coats. The capacity of the bag should be so great in proportion to the volume of the seeds being treated that they will be very free to move about inside the bag during the treatment. At the end of the time specified in Table 1 for the particular kind of seed being treated, remove the bag, with its contained seeds, from the solution, allow to drain for a minute or two, and then immerse in clean running water for 15 minutes, before tipping out the seeds in a clean shady place to dry before re-packeting or sowing. If repacketing the seeds, use a brand new packet, the old one having in the meantime been destroyed by fire, or in some similar manner, and the hands having been thoroughly washed with soap and water before handling the seeds again.

#### SEED-BED DISINFECTION.

It is of little use going to all the trouble, time and expense of seed disinfection if the disinfected seeds are then to be planted into infected soil.

Where seeds are planted in seed-beds from which the seedlings are subsequently transplanted into the field or garden, as in the case of many vegetable and flower-garden plants, the simplest and cheapest means, in many cases, of avoiding infection from the soil, is to prepare a new seed-bed each time from soil which has not previously grown any of the same or closely-related kinds of plants.

If this method is impracticable on account of the limited area of suitable soil on the property, or for any other reason, it may be necessary to use an old seed-bed many times over. In such instances some form of seed-bed disinfection should always be practised. The most commonly used seed-bed disinfectants are steam, fire, or formalin.

#### STEAM STERILISATION.

When properly used, steam is the most effective sterilising agent for soil yet known. Some of the more common methods by which it is applied in other countries are by the use of underground drain tiles, covered perforated steam pipes, the "inverted pan" and "steam rake." Where steam heating outfits for glasshouse crops are very common, as in England and many parts of the United States, it is natural that steam sterilisation of the soil should be much practised. Owing to the almost complete absence of such equipment from the market- and flower-gar-

dens of this State, however, steam sterilisation is for the most part quite impracticable. The only method which could be at all conveniently used, and then only in rare instances, is that known as the "inverted pan" system.

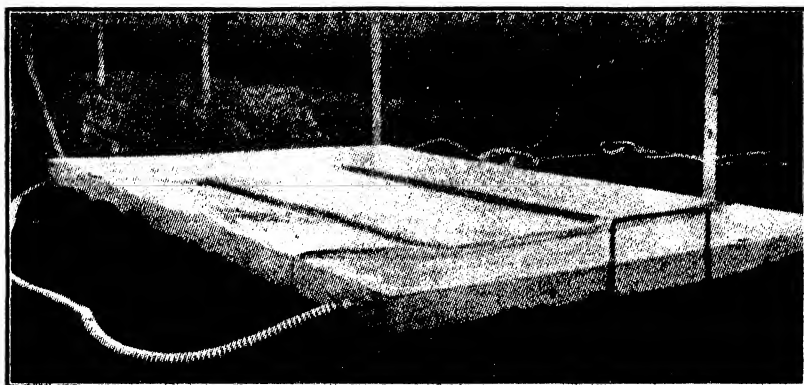


Fig. 1. Showing a method of sterilising soil by steam, using the "inverted pan" system. Note the flexible steam pipe entering the heavy-gauge galvanised iron pan at the front left corner. Note also the handle at the front for lifting the pan from one site to another. The rear handle is hardly obvious in the photograph.—After Chapp, "*Manual of Vegetable Garden Diseases*."

This involves the use of a steam boiler, from which steam under a pressure of about one hundred pounds to the square inch is forced through flexible, heavy rubber hose, into an oblong shallow pan of heavy-gauge galvanised iron, or boards, which has been turned upside down over the seed-bed to be sterilised. The usual time for sterilising under the pan is from one-half to one and one-half hours at a pressure of 80 to 100 lbs. (see Fig. 1). Further details may be obtained, if required, on application to the Department of Agriculture.

#### STERILISATION BY FIRE.

A method which is much in use in Australia, as well as other countries, especially for tobacco seed-beds, is by the use of a sustained wood fire on the site of the bed for at least four hours. This method is very cheap in many country districts where wood can be obtained for the mere labour of collecting it, and it deserves to be used much more extensively in market- and flower-garden practice than it is at present. In addition to its beneficial action in destroying harmful organisms, the resultant wood ashes from the fire add a valuable fertilising ingredient to the soil. The heat should be sufficient to cook a 4oz. potato buried in the soil three inches deep, or an egg buried five inches deep.\*

#### STERILISATION WITH FORMALIN.

Formalin may be used very effectively for sterilising seed-beds, its only disadvantages being that it is rather expensive and that the treatment must be commenced about a fortnight or so before the seeds are to be sown.

The formula now being mostly recommended is 1 gallon of commercial (40 per cent.) formalin to 49 gallons of water (*i.e.*, a 2 per cent. solution). The solution so prepared is applied with a watering-can to the soil, which should previously have been well loosened up, at the rate of about one-half to one and one-half gallons

\* N. A. R. Pollock, "Tobacco Seed Beds," Queensland "*Agricultural Journal*," Vol. 34, Part 4, pp. 408-412, October, 1930.

of the solution to the square foot. The heavier the soil, the more needs to be used. The treated soil is then smoothed down and covered with bags moistened with the formalin solution, and left for several days. Forty-eight hours is usually enough, but no harm will be done if the covers are left on for a longer period. The bags are then removed and the soil thoroughly stirred with implements previously sterilised in steam, fire, or formalin, so as to let out the fumes. The stirring process should be repeated several times during the next ten days or a fortnight, after which the seeds may be safely sown.

#### GENERAL WARNING AGAINST RE-CONTAMINATING DISINFECTED SEED-BEDS.

Great care should always be taken after any soil-sterilising process not to re-contaminate the soil by using undisinfected implements from infected ground, or by walking over the beds with contaminated boots, etc. This is very important, inasmuch as soil-inhabiting disease organisms spread much more rapidly through sterilised than unsterilised soil, owing to the killing off, in the sterilising process, of the other organisms in the ground which would ordinarily compete with or attack them.

#### CHESHUNT MIXTURE—FOR CHECKING DAMPING-OFF AND ROOT-ROT OF SEEDLINGS.

This mixture was developed by Dr. W. F. Bewley at the Experimental and Research Station of the Nursery and Market Garden Industries' Development Society, at Cheshunt, England, especially to control "damping-off" and root-rotting fungi in tomato seed-beds or -boxes which had not been sterilised, or which had become re-infected by some mischance after the sterilising process. The following extracts from Dr. Bewley's book, "Diseases of Glasshouse Plants," pages 61 and 62, describe the preparation and uses of this substance, which has the great advantage over most other disinfectants that it may be used for watering around the base and roots of growing plants without injuring them:—

"The mixture, which for convenience has been named 'Cheshunt Compound,' consists of *two parts by weight of copper sulphate (bluestone) and eleven parts by weight of ammonium carbonate.*"

"The ammonium carbonate, *which must be fresh*, is reduced to a fine powder by crushing out the lumps. It is then thoroughly mixed with powdered copper sulphate in the correct proportions, and stored for twenty-four hours in a tightly corked glass or stone jar before using."

"The solution is prepared by dissolving one ounce of the dry mixture in a little hot water and adding to two gallons of water. It should not be put into vessels of iron, tin or zinc, as it corrodes them and loses its strength, and just as much as is required for immediate use should be prepared."

"Plants may be watered (around the base) with this solution without injury, while the 'damping-off' organisms in the soil are destroyed, but infected plants receive no benefit, for the fungus is already inside the tissues where the liquid cannot reach it, and such plants eventually die."

*To use:*—Pull up affected plants, water the soil from which they have been taken, and the ground at the base of the neighbouring plants, with the Cheshunt mixture to prevent attack. In replacing diseased individuals, the method should be to remove the affected plant, water the hole with a pint of solution, replant with a healthy individual, and again water with the solution.

In addition to vegetable-garden plants, Cheshunt mixture has been successfully employed to control *Phytophthora spp.* and similar root- and stem-rotting organisms of Iceland Poppies, Stocks, *Phlox drummondii*, and other flower-garden plants.

## HERD TESTING.

THE OFFICIAL AUSTRALIAN PURE BRED DAIRY CATTLE PRODUCTION TESTING SCHEME.  
Conducted by Dairy Branch, Department of Agriculture, Western Australia. Year ending 30th June, 1931.

Name of Cow.	Owner.	Breed.	Herd Book No.	Age.	Date of Calving.	No. of Days in Test.	Weight of Milk for Period.	Average Test.	Total Butter Fat.	Weight of Milk last day of Test.	Sire.
MATURE COWS—STANDARD 350 LBS. BUTTER FAT.											
Gentle of Blackheath ...	E. McManus	M.S.	11679	10	1	25-10-29	273	16,669	3.82	11.8.	Flower's Mayfield of Blackheath. 370
Charming Lass of Greenmount ...	A. J. B. Strempe	Jersey	20903	5	2	31-7-30	273	8,500	6.28	533.91	Werribee Starbright's King. 2002
Lady Fowler 3rd of Grass Vale ...	R. H. Rose	do.	19111	5	0	26-5-30	273	10,041	5.12	524.88	Rye Duke of Glen Iris. 1894
Koolan Dule ...	A. W. Padbury	Guernsey	1255	6	4	16-8-30	273	10,281	5.09	524.09	Robin of Nunorah. 417.
Melba 69th of Darbalara ...	W. G. Burges	M.S.	14074	5	8	7-7-30	273	11,055	4.4	480.42	Re Echo of Darbalara. 2254
Maldia 7th of Berry ...	do.	do.	15702	6	8	29-9-30	273	8,325	4.43	474.98	Rutland of Darbalara. 575
Topsy Rye of Grass Vale ...	C. H. Ironmonger	Jersey	17387	7	1	10-8-30	273	8,314	5.64	472.70	Rye Duke of Glen Iris. 1894
Charming Bells of Greenmount ...	A. J. B. Strempe	do.	17387	6	3	9-10-30	273	10,679	4.42	440.79	Werribee Starbright's King. 2002
Pansy 5th of the Hill ...	W. G. Burges	M.S.	12827	5	0	5-2-30	273	10,066	4.31	435.13	Cr-scent of the Hill. 2016
Dahlia 5th of Berry ...	do.	do.	12827	6	1	14-3-30	273	8,544	5.29	432.19	Mirth of Berry. 1716
Buttercup of Venton ...	R. H. Rose	Jersey	20914	8	2	12-7-30	273	7,548	5.37	407.94	Ingot of Banyule. 1413
Sparkle of Trelawney ...	Miss L. Hancock	do.	1121	6	4	25-9-30	273	7,554	5.37	404.73	Trelawney. 3426
Colleen of Rosewood ...	Dept. of Agriculture	Guernsey	1121	8	8	6-10-30	273	7,382	5.15	403.12	Archer of Andorah
Woolongbar Dessie 2nd ...	Murek College	do.	13200	6	4	19-8-30	273	7,435	4.15	380.45	Renown of Woolongbar. 415
Butterfly of Waterside ...	Sauatorium Farm	M.S.	6707	7	2	19-4-30	240	7,355	4.01	388.70	Premier of Waterside. 511
Marinora of Tellaraga ...	A. J. B. Strempe	Jersey	8930	13	2	31-5-30	273	7,679	5.07	380.07	Reford Marfara. 890
Lass of Moorlands ...	P. Rose	do.	13523	9	10	2-4-30	273	7,096	5.42	381.08	None's Advance of Garden H. 11.
Dinah of Moorlands ...	do.	do.	13523	10	0	15-6-30	273	7,096	5.42	381.08	2273
Pink Pearl 4th of Mayfield ...	D. Bevan	M.S.	18111	9	0	21-8-30	273	10,653	4.12	375.30	Reveler of Melrose. 1804
Lucky Pretty Maid 3rd of East View ...	A. E. Grant	M.S.	18111	5	2	14-12-29	273	8,294	4.54	374.69	Denance of Oakdale View
Starbright's Duchess of Grass Vale ...	R. H. Rose	Jersey	19111	5	8	20-8-30	273	7,506	4.97	373.29	Lucky Boy of East View
Glen Iris Dolly Grey ...	C. Gandy	Friesian	2187	5	9	10-6-30	273	10,548	3.49	368.12	Starbright's Sweet Duke of Glen Iris. 3710
Denmark Anne ...	Dept. of Agriculture	Guernsey	1164	5	2	10-5-30	273	6,812	5.37	366.37	Teawood of Woolongbar. 381
Maid of Moorlands ...	P. Rose	Jersey	20846	8	10	25-4-30	273	7,724	4.65	359.13	Reveler of Melrose. 1804
Tesse of Garden Hill ...	W. Padbury	do.	13348	7	10	23-8-30	273	8,306	4.55	359.23	Crown Socks of Glen Iris. 1410
Cowslip 6th of Darbalara ...	W. G. Burges	M.S.	19127	7	9	3-6-30	273	8,365	4.75	355.58	Windsor of Darbalara. 1444
Lydia of Moorlands ...	P. Rose	Jersey	1128	5	7	30-4-30	273	7,743	4.57	354.09	Top North of Reelands. 4011
Woolongbar Golden Pearl 5th ...	Murek College	Guernsey	1128	5	7	15-4-30	273	5,826	5.85	341.08	Judge of Woolongbar. 184
Jewel of Moorlands ...	P. Rose	Jersey	20822	5	1	30-6-30	273	7,018	4.73	339.20	Grafter of Melrose. 3560
Woolongbar Beam 2nd ...	Murek College	Guernsey	1151	6	4	30-6-30	273	7,053	4.84	334.71	Bellman of Woolongbar. 334
Spurfield Air Girl 2nd ...	Murek College	Guernsey	13757	6	4	8-8-30	273	6,555	5.06	329.27	Milton's Steadfast. 292
Lady Fowler 3rd of Bentonia ...	R. H. Rose	Jersey	12847	10	0	15-9-30	240	8,295	3.74	310.74	Ingot of Banyule. 1413
Thelma of Blackheath ...	H. O. Timmis	M.S.	12847	10	0	15-9-30	240	8,295	3.74	310.74	Flower's Mayfield of Blackheath. 370



Makara of Grass Vale	...	C. H. Ironmonger	Jersey	12257	7	10	1-5-30	273	7,297	4-19	306-41	171	Makara, 995
Denmark Red Rose	...	Dept of Agriculture	Jersey	1357	5	3	6-9-30	273	4,863	6-0	291-89	11	Rose Chief of Wollongbar, 130
Grass Vale Fairy Rye	...	C. H. Ironmonger	Jersey	23689	5	3	11-9-30	273	7,361	3-81	290-84	151	Rye Duke of Glen Iris, 1994
Violet 1st of Glen Avon	...	M.S.	do.	...	5	10	18-7-30	273	8,063	3-54	286-23	191	Premier of Blackheath, 1740
Melba 42nd of Darbarala	...	W. G. Burges	do.	12134	6	8	12-2-30	250	5,985	4-73	263-28	36	Lime-light of Darbarala, 1105
Boronia Rye of Grass Vale	...	C. H. Ironmonger	Jersey	17529	6	8	8-4-30	240	6,675	3-94	263-10	19	Rye Duke of Glen Iris, 1994
The Flower of Lilgarup	...	H. O. Thums	M.S.	14747	8	0	15-4-30	240	6,840	3-83	262-26	12	Earl of Blackheath, 967
Violet 8th of Oakdale	...	D. Bexan	do.	12931	10	4	4-5-30	273	6,465	3-98	257-52	141	Standard of Oakdale, 226
Garfield of Oakleigh	...	C. Candy	do.	1560	6	8	6-3-30	210	7,178	3-55	254-77	191	Garfield of Oakleigh, 1623
Grandon Lydia	...	Freisian	do.	15069	6	8	14-5-30	210	6,645	3-58	237-81	25	Tetyarup Prince of Claremont, 2352
Pendlam Blossom 4th of Claremont	...	M.S.	do.	...	6	11	1-7-30	210	6,285	3-78	237-66	101	Tetyarup Prince of Claremont, 2352
Della 11th of Oakdale	...	H. O. Thums	do.	9355	Aged	...	18-10-30	240	5,985	3-92	234-54	101	Norval of Darbarala
Maggie Morrison 2nd of Claremont	...	Hospital for Insane	do.	...	8	2	28-1-30	240	6,195	3-62	224-22	13	Norval of Darbarala
Jessica of Grass Vale	...	A. Plele	Jersey	15693	7	6	3-4-30	210	5,325	4-18	222-72	13	King George of Yarralla, 1271
Milkmaid 1st of Blackheath	...	M.S.	do.	10091	12	2	21-9-30	240	5,880	3-62	213-36	71	Flower's Mayfield of Blackheath, 370
Ultery 5th of Kelvin Park	...	Hospital for Insane	do.	...	6	7	2-6-30	273	5,185	4-09	212-34	131	Daddy Xmas of Woolbar, 928
Kapoon Dolly	...	A. W. Wilson	Guernsey	1454	5	4	3-10-30	240	5,160	3-89	201-12	131	Robin of Nundorah, 417
Famous 2nd of Mayfield	...	D. Bexan	M.S.	1165	9	4	19-3-30	273	5,203	3-7	192-52	141	Model's Lad of Mayfield, 1158
Wollongbar Bonnie Pearl	...	Dept. of Agriculture	Guernsey	19109	6	7	18-1-31	150	3,915	4-85	190-05	241	Bounty of Wollongbar, 336
Capture of Grass Vale	...	A. Plele	Jersey	1430	5	4	12-9-30	150	3,675	4-4	161-70	171	Rye Duke of Glen Iris, 1994
Denmark Rose Pearl	...	Dept of Agriculture	Guernsey	1430	5	4	12-9-30	150	3,675	4-4	161-70	171	Rye Duke of Glen Iris, 1994
Starbright's Duchess of Glen Iris	...	Mrs. B. Burnside	Jersey	14176	7	1	15-10-30	90	2,715	5-52	152-64	131	Rose Chief of Wollongbar, 130
Golden Noble Princess of Glen Iris	...	W. Padbury	do.	12965	7	1	15-10-30	90	2,715	5-52	152-64	131	Rose Chief of Wollongbar, 130
Spurfield Alma	...	Muresk College	Guernsey	1049	5	5	2-4-30	150	2,315	5-36	124-26	11	Sweetbread's Duke of Glen Iris, 1918
Boronia of Grass Vale	...	A. Plele	Jersey	9994	11	3	27-11-30	60	1,785	3-28	58-62	261	Mercedes Prince of Glen Iris, 1917
COWS OVER 4 YEARS AND UNDER 5 YEARS--STANDARD 330 LBS. BUTTER FAT.													
Royal Lady of Kurrawong	...	W. G. Burges	M.S.	...	4	9	16-1-30	273	10,635	4-0	426-05	281	Count Hughes of Cosey Camp, 2011
Bo Peep of Greenmount	...	A. J. B. Stremple	Jersey	20902	4	11	21-6-30	273	7,521	5-52	400-60	22	Werrabee Starbright's King, 2692
Silvermine 2nd of Garden Hill	...	W. Padbury	do.	20879	4	11	22-10-30	273	6,993	5-47	392-58	21	Cream Socks of Glen Iris, 1410
Peryl of Moorlands	...	P. Rose	do.	20886	4	11	5-6-30	273	8,640	4-24	366-56	15	Grater of Melrose, 3560
Sweet Duchess of Grass Vale	...	R. H. Rose	do.	23692	4	11	9-8-30	273	6,195	5-57	345-31	10	Starbright's Sweet Duke of Glen Iris, 3710
Hazel of Moorlands	...	P. Rose	do.	20891	4	9	24-4-30	273	6,840	4-62	316-25	15	Grater of Melrose, 3560
Denmark Rosa	...	Dept of Agriculture	Guernsey	1429	4	7	13-7-30	273	5,990	5-25	314-61	131	Rose Chief of Wollongbar, 130
Benmil of Moorlands	...	P. Rose	Jersey	20885	4	7	22-4-30	273	6,663	4-76	314-19	16	Colonel of Melrose, 4015
Band of Moorlands	...	do.	do.	20888	4	8	20-4-30	273	5,772	4-93	284-98	14	Grater of Melrose, 3560
Biddy 6th of Claremont	...	Hospital for Insane	M.S.	...	4	7	23-5-30	273	5,490	3-96	217-54	10	Tetyarup Prince of Claremont, 2352
COWS OVER 4 YEARS AND UNDER 4 1/2 YEARS--STANDARD 310 LBS. BUTTER FAT.													
Koolan Wavelet	...	A. W. Padbury	Guernsey	1619	4	1	18-9-30	273	8,610	5-06	435-78	20	Robin of Nundorah, 417
Maggie of Claremont	...	Hospital for Insane	M.S.	...	4	5	30-8-30	273	11,497	3-75	431-77	221	Searchlight of Sunnyvale, 2302
Kathleen 5th of Kurrawong	...	W. G. Burges	do.	...	4	3	6-3-30	273	10,110	4-15	419-66	25	Premier of Kurrawong, 1212
Daphne 7th of the Hill	...	do.	do.	...	4	3	5-10-30	273	10,028	4-08	418-11	31	Grescent of the Hill, 2016
Pride 4th of Kurrawong	...	do.	do.	...	4	5	20-2-30	273	10,028	3-98	399-60	241	Premier of Kurrawong, 1212
Moorlands Agnes	...	P. Rose	Jersey	25679	4	1	12-6-30	273	7,038	5-09	358-87	11	Colonel of Melrose, 4015
Moorlands Agnes	...	do.	do.	25680	4	1	17-7-30	273	7,593	4-86	369-08	16	Colonel of Melrose, 4015
Moorlands Anne	...	do.	do.	25686	4	3	4-9-30	273	6,394	5-27	337-28	111	Colonel of Melrose, 4015

## HERD TESTING—continued.

Name of Cow.	Owner.	Breed.	Herd Book No.	Age.	Date of Calving.	No. of Days in Test.	Weight of Milk for Period.	Average Test.	Total Butter Fat.	Weight of Milk Last day of Test.	Sire.
COWS OVER 4 YEARS AND UNDER 4 YEARS—STANDARD 310 LBS. BUTTER FAT—continued.											
Mokine Heroine 3rd	T. H. Wilding	Jersey	...	4	6-9-30	273	6,108	5.14	314.00	6	Mokine Hood, 4925
Nooka Queen	T. P. Herbert	do.	23664	4	1-7-30	273	6,691	4.52	302.35	154	Jessie's King of Sarnia, 4578
Lady Fowler 6th of Grass Vale	R. H. Rose	do.	24928	4	30-7-30	273	5,781	5.22	301.81	12	Carnation's Masterpiece of Garden Hill
Moorlands Alma	P. Rose	do.	23684	4	18-9-30	273	5,925	4.88	289.40	15	Colonel of Melrose, 4015
Kooljan Lady Buller	A. W. Wilson	Guernsey	1259	4	3-11-29	273	5,286	5.33	282.25	12	Robin of Nundorah, 417
Kooljan Lady Buller	A. W. Wilson	do.	1254	4	2-11-29	273	6,504	4.12	268.49	18	Robin of Nundorah, 417
Melaine Fairy Lily 9th	T. H. Wilding	Jersey	...	4	2-9-30	273	4,530	5.5	249.15	10	Mokine Hood, 4925
Clara 3rd of Claremont	Hospital for Insane	M.S.	...	4	23-8-30	273	5,901	4.11	242.49	12	Telvarup Prince of Claremont, 2352
Whitby Maid 5th of Claremont	do.	do.	...	4	1-9-30	273	5,460	4.34	237.00	154	Searchlight of Sunnyside, 2302
Minnamurri Fairy Queen	Giblett & Johnston	Guernsey	1392	4	1-8-30	180	4,030	5.35	217.00	114	Minnamurra Golden Lad, 402
Pet 5th of Kurrwong	A. E. Grant	M.S.	...	4	10-8-30	450	5,220	3.89	202.62	244	Premier of Kurrwong, 1212

## COWS OVER 34 YEARS AND UNDER 4 YEARS—STANDARD 290 LBS. BUTTER FAT.

Kooljan Bonnie Jean	A. W. Padbury	Guernsey	1612	3	8	14-11-29	273	9,462	5.75	544.50	29	Robin of Nundorah, 417
Kooljan Ida	do.	do.	1900	3	3	2-9-30	273	7,632	5.28	403.00	18	Robin of Nundorah, 417
Moorlands April	P. Rose	Jersey	23667	3	9	5-6-30	273	7,776	4.99	388.25	12	Colonel of Melrose, 4015
Colman's Lady	C. H. Ironmonger	do.	...	3	7	13-8-30	273	8,581	4.36	371.46	294	Roland's Mildred, 5611
Kooljan Bluebell	A. W. Wilson	Guernsey	1674	3	11	12-4-30	273	6,392	5.56	320.37	134	Robin of Nundorah, 417
Juadine Dianthus 2nd	Miss L. Hancock	Jersey	23713	3	8	18-6-30	273	5,665	5.66	320.92	134	Wolke's Best of Garden Hill, 1756
Murek Lily	Murek College	Guernsey	1801	3	7	29-8-30	273	5,874	5.92	306.93	18	Woolongbar Triumph, 513
Juadine Sparkle	Miss L. Hancock	Jersey	24716	3	7	22-3-30	273	6,270	4.79	300.87	20	Woolongbar Triumph, 513
Diamond 3rd of Raleigh	D. Bevan	M.S.	...	3	11	16-10-30	273	7,740	3.85	298.11	10	Union Jack of Raleigh, 2375
Gold X of Raleigh	do.	do.	...	3	7	9-6-30	273	7,455	3.95	296.11	10	Union Jack of Raleigh, 2375
Spring Park Rye Queen	C. H. Ironmonger	Jersey	23657	3	7	14-2-30	273	6,015	4.85	291.80	20	Rye Duke of Glen, 1731
Moorlands Betty	do.	do.	24922	3	8	18-8-30	273	5,601	5.2	291.84	12	Grafter of Melrose, 326
Woolongbar Betty 2nd	Murek College	Guernsey	1571	3	9	17-4-30	273	5,208	5.51	287.07	16	Honour of Woolongbar, 326
Woolongbar Betty 2nd	D. Bevan	M.S.	...	3	8	29-6-30	273	7,926	3.67	283.69	17	Union Jack of Raleigh, 2375
Woolongbar Betty 2nd	do.	do.	...	3	7	14-7-30	273	6,711	4.02	269.67	22	Barrister of Raleigh, 2375
Glen 12th of Raleigh	do.	do.	24712	3	10	25-7-30	273	4,114	6.34	261.19	64	Cream Socks of Glen Iris, 1410
Glen Hill 1st of Raleigh	Giblett & Johnston	Guernsey	1866	3	11	3-9-30	273	5,434	4.68	256.72	8	Minnamurra Golden Lad, 402
Minnamurra Joy	Mrs. B. Burnside	Jersey	24705	3	7	21-5-30	240	4,755	4.06	235.20	104	Starbright's Sweet Duke of Glen Iris, 3710
Cratcock's Lady Lily	do.	do.	...	3	10	11-3-30	273	5,347	3.5	187.42	124	Starbright's Sweet Duke of Glen Iris, 3710
Beanie 2nd of Claremont	Hospital for Insane	M.S.	...	3	9	30-5-30	240	3,255	4.59	149.43	6	Starbright's Sweet Duke of Glen Iris, 3710
Grass Vale Sweet Maggie	A. Pele	Jersey	23677	3	11	17-9-30	90	2,905	5.07	114.76	224	Judge of Woolongbar, 184
Minnamurra Judith	Giblett & Johnston	Guernsey	1867	3	11	17-9-30	90	2,905	5.07	114.76	224	Judge of Woolongbar, 184

COWS OVER 3 YEARS AND UNDER 34 YEARS—STANDARD 270 LBS. BUTTER FAT.									
Kitty 8th of Kurravong	W. G. Burges	M.S.	3	4	17-42-29	273	9,814	4-82	473-26
Greenmount Charming Bells 3rd	A. J. B. Strenpel	Jersey	3	3	17-30-30	273	7,332	5-28	387-47
Goodlands Biddy	P. Rose	do.	3	4	10-7-30	273	7,240	5-33	386-20
Wing Wing of Wooroloo	Sanatorium Farm	M.S.	3	4	24-10-29	273	9,160	3-76	345-25
Murek Buttercup	Murek College	Guernsey	3	4	15-8-30	273	6,615	5-15	340-57
Grass Vale Montrose Maid	R. H. Rose	Jersey	3	4	8-10-30	273	6,348	5-32	337-17
Star of Claremont	Hospital for Insane	M.S.	3	3	24-9-30	273	8,709	3-8	331-15
Murek Carnation	Murek College	Guernsey	3	3	17-8-30	273	6,471	4-98	322-40
Picture 8th of Raleigh	D. Bevan	M.S.	3	3	16-9-05	273	8,048	3-88	322-56
Goodlands Brenda	P. H. Rose	Jersey	3	1	18-7-30	273	6,417	4-77	306-43
Grass Vale Montrose Nora	P. H. Rose	do.	3	1	26-8-30	273	5,270	5-77	304-53
Murek Pansy	Murek College	Guernsey	3	3	4-9-30	273	6,638	6-09	282-36
Cherry 1st of Claremont	Hospital for Insane	M.S.	3	3	1-8-30	273	7,938	4-05	281-05
Bellefaira Spotted Socks	Mrs. B. Burnside	Jersey	3	3	27-3-30	273	4,977	5-43	270-16
Nancy 9th of Raleigh	D. Bevan	M.S.	3	3	8-9-30	273	6,111	4-77	268-98
Denmark Red Rose 2nd	Dept. of Agriculture	M.S.	3	3	17-11-29	273	4,800	5-28	253-66
Elsie 4th of Raleigh	D. Bevan	M.S.	3	3	10-7-30	273	6,641	3-58	238-33
Denmark Gladys	Dept. of Agriculture	M.S.	3	3	15-5-30	180	3,853	5-69	221-19
Minnamurra Millicent	Giblett & Johnston	Guernsey	3	2	31-10-29	273	5,115	4-16	213-01
Rachel 4th of Claremont	Hospital for Insane	M.S.	3	2	18-7-30	273	6,204	3-37	202-09
Treasure of Claremont	do.	do.	3	1	17-10-29	273	5,830	3-23	188-04
Cleggett 2nd of Claremont	do.	do.	3	2	25-12-29	273	4,618	4-05	187-17
Woolongbar Rachel	do.	Guernsey	3	2	29-11-29	273	3,526	5-27	185-81
Minnamurra Lady Love	Giblett & Johnston	do.	3	3	10-8-30	180	3,255	5-10	166-26
HEIFERS OVER 24 YEARS AND UNDER 3 YEARS—STANDARD 250 LBS. BUTTER FAT.									
Sally of the Hill	W. G. Burges	M.S.	2	1	30-5-30	273	9,936	4-11	408-43
Spring Park Starbright's Queen	A. W. Padbury	Jersey	2	1	22-10-30	273	7,473	5-27	393-44
Denmark Rose Dame	Dept. of Agriculture	Guernsey	2	1	25-3-30	273	7,948	4-94	393-23
Minnamurra Judy	Giblett & Johnston	do.	2	1	28-2-30	273	5,607	5-68	319-06
Denmark Rose Pearl 3rd	Dept. of Agriculture	do.	2	1	30-8-30	273	5,310	5-83	309-50
Denmark Rose Pearl 2nd	do.	do.	2	1	27-9-29	273	4,613	5-51	300-31
Mokine Empire Lily 12th	T. T. Whitling	Jersey	2	1	5-9-30	273	4,065	7-35	298-72
Moordlands Rita	F. Rose	do.	2	1	18-8-30	273	5,584	5-1	285-68
Moordlands Rot	Giblett & Johnston	do.	2	1	13-8-30	273	5,562	4-89	283-56
Minnamurra Lady Love	P. Rose	Guernsey	2	1	19-10-29	273	5,536	5-09	268-63
Moordlands Bijou	P. Rose	Jersey	2	1	20-8-30	273	5,298	5-09	266-96
Cherry 2nd of Claremont	Hospital for Insane	M.S.	2	1	13-8-30	273	5,750	4-44	255-44
Wooka Pearl	T. P. Herbert	Jersey	2	1	15-9-30	257	4,708	5-1	254-25
Roslyn 2nd of Raleigh	D. Bevan	M.S.	2	1	20-7-30	273	6,336	4-0	253-52
HEIFERS OVER 24 YEARS AND UNDER 3 YEARS—STANDARD 250 LBS. BUTTER FAT.									
Koojan Gem	A. W. Wilson	Guernsey	2	1	29-10-29	273	5,329	4-73	252-17
Famous Star of Glen Avon	D. Bevan	M.S.	2	1	12-3-30	273	6,202	4-04	250-99
Rachel 5th of Claremont	Hospital for Insane	do.	2	1	17-9-30	273	5,889	3-68	216-70
Spring Park Sweet Ginger	W. Padbury	Jersey	2	1	18-3-30	273	3,906	5-06	197-60
Colony's Veronica	C. R. Ironmonger	do.	2	1	15-9-30	273	4,183	4-72	197-44
Whitby Maid 6th of Claremont	Hospital for Insane	M.S.	2	1	27-5-30	240	4,920	3-67	180-57
Dolly of Brush Grove	R. H. Rose	do.	2	1	16-11-29	273	3,690	3-81	116-85
Corn II. of Brush Grove	do.	do.	2	1	6-12-29	180	3,045	3-81	116-01

Premier of Kurravong, 1212

Worribee Starbright's King, 2602

Colony's Biddy, 4015

Eclipse of Wooroloo

Triumph of Wooroloo, 513

Montrose East of Glen Iris, 4140

Teliarup Prince of Claremont, 2352

Triumph of Wollongbar, 313

Union Jack of Raleigh, 2375

Graftor of Melrose, 3560

Montrose East of Glen Iris, 4140

Triumph of Wollongbar, 313

Worribee Prince of Claremont, 2352

Union Jack of Raleigh, 2375

Rose Chief of Wollongbar, 130

Union Jack of Wollongbar, 130

Rose Chief of Wollongbar, 130

Noble's Best of Garden Hill

Graftor of Melrose, 3560

Zenith of Moorlands, 4581

Minnamurra Viscount, 682

Graftor of Melrose, 3560

Teliarup Prince of Claremont, 2352

Jessie's King of Sarnia, 4578

Union Jack of Raleigh, 2375

Koojan Golden Governor, 595

Premier of Blackheath

Princess of Darbarata

Princess of Darbarata

Roeland's Mildred, 5611

Searchlight of Sunnyvale, 2302

Ardee of the Hill

Ardee of the Hill

## HERD TESTING—continued.

Name of Cow.	Owner.	Breed.	Herd Book No.	Age.	Date of Calving.	No. of Days in Test.	Weight of Milk for Period.	Average Test.	Total Butter Fat.	Weight of Milk Last day of Test.	Sire.
Red Rose of Woolooloo	Sanatorium Farm	M.S.	...	4	27-6-30	273	9.128	4.18	382.53	26	Triumph of Pine Creek, 2515
Linelight's Camella of Wangara	W. G. Burges	do.	...	5	17-12-29	273	8.250	4.26	351.49	30	Linelight of Darbarala, 1105
Victress of Toora	do.	do.	...	5	20-8-30	273	7.455	4.63	345.30	10	Victor of Darbarala, 2381
Denmark Rose Marie	Dept. of Agriculture	Guernsey	1796	5	27-3-30	273	6.000	5.52	331.31	15	Wollongbar Reformer, 538
Kooljan Trequean Fanny	A. W. Padbury	do.	2334	1	24-9-30	273	6.504	5.03	327.17	18	Kooljan Golden Governor, 595
Moorlands Chloe	P. Rose	Jersey	...	0	18-5-30	273	6.102	5.33	325.56	14	Colonel of Melrose, 4015
Juadine Belvedere	Miss L. Hancock	do.	...	1	4-6-30	273	5.976	5.37	320.89	17	Mokine Hero
Juadine Sparkle 2nd	do.	do.	...	3	9-8-30	273	6.456	4.9	316.43	17	Mokine Hero
Colmyn's Tojazz Girl	C. H. Ironmonger	M.S.	24988	4	13-11-29	273	5.840	5.35	312.09	181	Roeblands Milord, 5611
Empress 4th of the Hill	W. G. Burges	do.	...	4	6-10-30	273	7.608	4.1	312.09	21	(rescent of the Hill, 2016
Moorlands Camella	P. Rose	Jersey	...	0	20-6-30	273	6.508	4.60	305.69	91	Colonel of Melrose, 4015
Moresk Rose	Moresk College	Guernsey	...	1	10-6-30	273	5.313	5.59	297.47	16	Triumph of Wollongbar
Juadine Peerless Lily 3rd	Miss L. Hancock	do.	...	0	24-9-30	273	5.394	5.5	296.25	13	Sonny of Juadine
Lady Fowler 6th of Grass Vale	R. H. Rose	M.S.	2135	11	22-5-30	273	5.452	5.43	292.87	17	Mokine Christopher Columbus, 1999
Spangle 8th of the Hill	W. G. Burges	do.	...	1	10-6-30	273	5.070	5.77	292.87	15	Rescent of the Hill, 2016
Kooljan Daffodil	A. W. Padbury	Guernsey	2231	1	2-10-30	273	6.471	5.43	293.34	17	Kooljan Golden Governor, 595
Moresk Daisy	Moresk College	do.	24900	2	10-8-30	273	6.210	4.65	289.17	20	Wollongbar Triumph, 513
Spring Park Dora	P. Rose	Jersey	1791	5	10-5-30	273	5.690	4.94	283.04	131	Colonel of Melrose, 4015
Denmark Pamela	Dept. of Agriculture	Guernsey	...	0	12-3-30	273	5.690	4.94	283.04	131	Rose Chief of Wollongbar, 130
Mokine Heron 5th	T. H. Wilding	do.	...	1	22-9-30	273	5.691	4.87	277.42	12	Twylsh Fox of the Valley, 5623
Juadine Juliet 5th	Miss L. Hancock	Jersey	...	1	7-9-30	273	5.103	5.004	269.46	11	Mokine Hero
Mokine Empire Lily 13th	T. H. Wilding	do.	...	1	22-9-30	273	5.103	5.004	269.46	11	Mokine Hero
Camella of Tipperary	P. Rose	M.S.	21590	10	11-6-30	273	5.355	4.91	266.50	13	Searchlight of Darbarala
Colmyn's Cherry	P. Rose	Jersey	2157	10	10-11-29	273	5.273	4.94	261.43	174	Roeblands Milord, 5611
Colmyn's Veronica	C. H. Ironmonger	do.	...	1	1-8-30	273	5.115	5.00	260.58	15	Wollongbar Triumph, 513
Moresk Violet	Moresk College	Guernsey	...	4	16-6-30	240	5.070	5.10	260.07	114	Grafter of Melrose, 3560
Moorlands Cora	Miss L. Hancock	Jersey	...	10	12-7-30	273	5.190	4.95	256.31	15	Twylsh Fox of the Valley, 5623
Nooka Carnation	S. P. Herbert	do.	...	4	10-9-30	273	5.071	5.04	255.69	104	Jessie's King of Sarnia, 4578
Juadine Sparkle, 3rd	Dept. of Agriculture	Guernsey	1795	2	26-10-29	273	4.755	5.37	255.62	15	Rose Chief of Wollongbar, 130
Denmark Rose Lady	do.	M.S.	...	5	9-5-30	273	7.152	3.55	254.26	19	Royal Standard of Darbarala
Venus 8th of Raleigh	do.	do.	...	10	6-3-30	273	6.501	3.76	246.86	22	Standard of Darbarala
Gold XI. of Raleigh	T. H. Wilding	Jersey	...	10	27-3-30	273	4.458	5.48	244.59	11	Twylsh Fox of the Valley, 5623
Madilla of Tipperary	A. E. Grant	M.S.	...	10	25-4-30	273	4.458	5.48	244.59	11	Twylsh Fox of the Valley, 5623
Crantock's Starbright's Rose	Mrs. B. Burnside	Jersey	...	10	11-10-29	273	4.017	6.0	241.38	12	Crantock Starbright's Chief, 5740
Melba 1st of Tipperary	W. G. Burges	M.S.	...	1	25-10-29	273	3.064	4.71	238.96	18	Villiers of Darbarala
Spring Park Starbright's Queen	Moresk College	Guernsey	1592	1	25-10-29	273	4.491	5.18	233.02	17	Wollongbar Triumph, 513
Virginia 1st of Tipperary	A. W. Padbury	Jersey	24007	4	6-12-29	273	4.534	5.07	231.31	13	Prince Marina of Grass Vale, 4582
Colmyn's Princess	A. E. Grant	M.S.	17993	1	26-3-30	240	4.905	4.62	226.83	13	Villiers of Darbarala
Della 1st of Tilyrup	C. H. Ironmonger	Jersey	24896	2	8-7-30	273	4.623	4.85	224.59	11	Prince Marina of Grass Vale, 4582
Mavis 2nd of Claremont	A. E. Grant	M.S.	...	1	11-8-30	273	5.749	3.89	222.75	164	Baron of Darbarala
Colmyn's Princess Marina	Hospital for Insane	do.	24897	4	17-9-30	273	5.373	4.13	222.20	16	Telyrup Prince of Claremont, 2352
	C. H. Ironmonger	Jersey	...	4	17-9-30	273	4.657	4.7	219.18	124	Prince Marina of Grass Vale, 4582

Karridale Kathleen	A. W. Wilson	Guernsey	1979	1	11	30-10-30	273	4,305	5 08	219-04	10	Minnamurra Oliver Twist, 528
Beattie 3rd of Claremont	Hospital for Insane	M.S.	...	2	0	11-8-30	273	5,595	3 94	218-07	20	Duncan of Claremont, 2467
Karridale Pridie	A. W. Wilson	Guernsey	1081	4	10	28-10-30	273	4,801	4 54	217-95	154	Minnamurra Oliver Twist, 528
Donmark Irish Rose	Dept. of Agriculture	do.	2134	1	10	30-5-30	273	3,765	5 25	216-84	10	Rose, Chief of Wellencliar, 130
Hilda 3rd of Claremont	Hospital for Insane	M.S.	...	2	2	12-8-30	273	5,272	4 49	215-77	124	Searchlight of Sunnyvale
Gwen 2nd of Claremont	A. E. Grant	M.S.	...	1	12	12-8-30	273	5,592	3 72	208-06	14	Mariner of Greyloch
Laura 2nd of Claremont	Hospital for Insane	M.S.	...	2	0	21-5-30	273	5,260	3 92	206-33	184	Tullyrup Prince of Claremont, 2352
Pendula of East View	A. E. Grant	M.S.	...	2	0	11-5-30	273	5,263	3 72	197-16	17	Sultan of East View
Beauty 7th of Claremont	do.	do.	...	2	0	20-5-30	273	5,286	3 72	196-88	17	Tullyrup Prince of Claremont, 2352
Maggie Morrison 7th of Claremont	Mrs. B. Burnside	Jersey	...	2	1	7-2-30	273	4,836	4 02	194-66	17	Tullyrup Prince of Claremont, 2352
Crantock Cream Star	Hospital for Insane	M.S.	...	1	9	20-5-30	273	3,229	6 06	189-97	12	Crantock's Starbright's Chief, 5790
Buddy 9th of Claremont	do.	do.	...	2	0	5-8-30	273	4,754	3 94	187-63	164	Searchlight of Sunnyvale, 2302
Bonny of Tipperary	do.	do.	...	2	4	8-2-30	180	4,320	4 35	185-54	204	Searchlight of Sunnyvale, 2302
Princess Molly 2nd of Claremont	W. G. Burges	do.	...	2	0	5-8-30	273	4,754	3 94	187-63	164	Clinker of Claremont, 2465
Karridale Lady Birdy	Hospital for Insane	do.	...	2	4	8-2-30	273	4,320	4 35	185-54	16	Triumph of Berry
Yokline Ruby	A. W. Wilson	Guernsey	2523	1	5	20-9-30	273	3,061	5 73	176-80	144	Minnamurra Oliver Twist, 528
Virginia 2nd of Tipperary	T. H. Willing	M.S.	...	2	11	11-8-30	273	4,078	4 33	171-74	12	Mckine Hood, 4925
Daisy of Tipperary	A. E. Grant	do.	...	1	9	4-9-30	273	4,101	4 18	171-74	12	Villiers of Darbulara
Sundae of Glen Avon	do.	do.	...	2	5	10-5-30	273	4,320	4 03	169-41	15	Premier of Blackheath
Avoncourt's Catronia	P. Rose	Jersey	...	1	10	24-4-30	180	3,435	3 90	169-08	21	Lily's Prince of Grass Vale, 5179
Avoncourt's Jessie	A. Piele	do.	25070	1	11	11-3-30	210	2,925	4 86	167-19	114	Montrose East of Glen Iris, 4140
Nooka Wild Rose	T. P. Herbert	do.	...	1	9	21-4-30	120	2,310	4 24	98-10	184	Lily's Prince of Grass Vale, 5179
Avoncourt Marjette	A. Piele	do.	25071	2	4	9-11-30	60	2,075	4 25	88-29	194	Lily's Prince of Grass Vale, 5179
Foretada 4th of Claremont	Hospital for Insane	M.S.	...	2	3	25-11-30	120	1,935	3 74	72-42	134	Clinker of Claremont, 2456
Nooka Pridie	S. P. Herbert	Jersey	...	1	9	1-10-30	90	1,365	4 41	60-31	144	Jessie's King of Sarnia, 4578

## TOBACCO.

### NOTES FOR INTENDING GROWERS.

A. R. C. CLIFTON,

Officer in Charge of Irrigation.

The objective in growing tobacco is to produce a leaf having those desirable smoking qualities and colour which would enable it to be used for manufacturing purposes. The trade demands a bright coloured flue-cured leaf, possessing a mild and not objectionable aroma with good burn. These qualities are primarily influenced by soil and climate.

#### SOIL.

The tobacco plant, when once established, is hardy and will grow under a wide range of different soils and climatic conditions. Commercial tobacco, however, is not only exacting as to its requirements regarding the texture, colour and condition of the soil on which it is grown, but also in the necessary care and constant attention required during the growing period and in the process of curing. Flue-cured types are produced on a rather poor, light coloured sand, or loamy sand, and a better leaf is produced on the slopes than on the flats. Good drainage is absolutely essential.

Leaf produced on rich fertile soils or moist swamp land of either a heavy or light texture, possesses undesirable qualities which make it of little commercial value. The same applies to black sand or any soils which become waterlogged in winter.

Before spending any money in attempting to grow tobacco in localities which have not already been proved, it is first advisable to experiment on a small scale with a few plants. Only an actual test will determine if the soil is suitable for the production of tobacco with desirable qualities.

#### CLIMATE.

The growing period is during that part of the year when frosts are absent, *i.e.*, spring and summer. It is, therefore, necessary to have 6 or 7 inches of rain and freedom from frosts during such period.


Tobacco being a summer-growing plant, its cultivation under natural conditions must be confined to districts having a sufficient spring and summer rain, and to soils in which cultivation will retain sufficient moisture to promote steady and very regular development of the plant without check to its growth.

As this is a State of light average summer rainfall, it is important to have the seedling plants ready for planting out as early in the season as possible, say, September, or as soon as the danger of frost is over. This has been very clearly indicated in the tests carried out around Manjimup, and the results of last season's crop further emphasise the point. Last year's experience showed that the tobacco plant will grow with very little rain, for at Manjimup only 337 points fell between planting and harvesting of the experimental plots; but with such light rainfall the quality of the leaf suffered badly through insufficient moisture. Just what is the minimum satisfactory rainfall under South-West conditions for the tobacco plant has not yet been determined, but obviously the figure must vary with the nature of the soil. Soils that will retain their moisture through cultivation will require less









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rain to produce a good quality leaf than soils which dry out more quickly. One point in the cultivation of tobacco which should be stressed is that while the plant may survive a check and show no visible ill-effects, any interruption of normal growth depreciates the quality of the leaf. A humid atmosphere is very desirable, especially dewy nights when the plant is reaching maturity.

#### VARIETIES.

"Hickory Pryor," "Conqueror," "White Stem Orinoco," "Ad-ock" and "Warne" are all suitable for flue-curing.

#### SEED BEDS.

Particular care and attention is necessary in raising the seedlings in Western Australia, as our light summer rainfall makes it important to plant out as early as possible in the spring so as to catch the full benefit from the late spring rains. This means that the seed beds must be put down in winter. The best results in the South-West have been obtained by planting out in September, which means starting the seed beds at the beginning of July. The site of the seed bed should be carefully selected so as to catch as much sun as possible. It should therefore have a Northerly aspect, combined with good natural drainage. A dark sandy loam will be found most suitable.

Before sowing, the soil of which the seed bed is to be made should be sterilised. The simplest method of doing this is to burn the soil with a slow fire made of brush and wood until well burned. This will kill all weed seeds, disease spores, and clear the soil of insect pests. After the fire, all unburnt portions are raked off and the remaining ashes, together with 1 lb. per square yard of some good complete fertiliser, should be lightly worked into the soil. If it is not practicable to sterilise the seed bed by means of fire, formalin can be used, the method being to water the seed bed after it has been made with formalin solution at the rate of one gallon to every square foot of soil. The solution is made up at the rate of 1 gallon of commercial formalin to 50 gallons of water. After the solution has been applied a cover should be put over the bed for two days to prevent the fumes escaping. Covers should then be removed and the beds stirred and allowed to air for at least 10 days before sowing the seed. The land around the bed should be cultivated and kept bare of vegetation so as to destroy any plants or weeds which might harbour insect pests.

The bed should be built up above the surrounding land by jarrah boards on edge, the edges of the boards being several inches above the surface of the finished seed bed, which should not be flat, but have a good slope from back to front so as to get all the drainage possible. The slope should be towards the sun. To simplify weeding and looking after the beds generally, it is strongly recommended not to have the beds wider than 3ft. 100 square yards of seed bed is usually provided for each 5 acres.

After the soil has been worked to a fine tilth and levelled, the seed should be sown on the surface. The rate of seeding will, of course, depend upon the germinating power of the seed. An ounce of good seed will plant 100 square yards of seed bed. A simple way of sowing is to mix the seed with fine sifted wood ash and sow first lengthwise and then crosswise by shaking through a tin perforated with nail holes in the bottom. After sowing the seed the surface of the bed is firmed down with a board and watered thoroughly with a very fine rose watering can and the covers of calico, or some other suitable material then put on. The calico can be tacked to frames which rest on the edge of the timber around the seed beds.

If the seed bed is properly prepared in a warm sheltered position, germination should take from 6 to 12 days, depending on the weather. Seed sown in the open may take six weeks to germinate if weather conditions are unfavourable.

After seeding, it is most important to keep the surface moist, by watering as required, until the plants are up. After plants are showing the third leaf, the surface waterings should be reduced to a minimum and every opportunity should be taken during bright fine sunny days to raise the glass frames or calico coverings so as to harden the seedlings.

Any weeds must be removed as soon as they can be handled, and the plants should be thinned out to approximately one to the square inch.

Eight to ten weeks after germination, the plants should be ready to plant out.

In case of accidents, it is a good plan to grow twice as many plants as it is estimated will be required, and have three sowings at ten-day intervals.

### FIELD PREPARATION.

The land should be fallowed in the autumn and kept free from weeds with the cultivator. A second ploughing will be necessary in the spring about a fortnight or three weeks before planting out, and the surface worked to a fine tilth.

### FERTILISER.

The fertiliser recommended is—

100 lbs. Sulphate of Ammonia

50 lbs. Nitrate of Soda

600 lbs. Superphosphate

100 lbs. Sulphate of Potash

at the rate of 1,000 lbs. per acre. The fertiliser is applied along an open furrow which is then covered with a plough from each side and levelled off, the plants being set out on top of this covered-in furrow at 20in. intervals, the furrows or drills being spaced 3ft. 6in. apart.

### TRANSPLANTING.

When the plants are from three to four inches high, they are large enough to transplant into the field. The seed bed should be well watered before pulling, and care must be taken to avoid breaking the roots or damaging the hearts of the young plants.

Suitable weather should be selected for transplanting into the field, but should it be necessary to plant out when the weather is warm, each plant should be given a little water as it is set, even half a pint will greatly assist in getting an even stand.

It is good practice before pulling the plants out of the seed bed to first spray with an ansenate of lead mixture, half an ounce of powder to one gallon of water. This will protect the plants from cut worms. If this pest is in the field it is also recommended to lay down Paris Green and bran baits made up of bran 30 lbs., molasses 4 lbs., Paris Green 1 lb. The bran and poison powder should be thoroughly mixed in dry form—the molasses should then be mixed with the dry ingredients and water added with constant stirring until the bait is of a crumbly consistency. This bait should not be laid in direct contact with the seedlings.

The plants are handled by the tips of the leaves and should be set deep enough to enable the soil to keep the leaves wrapped around the heart of the plant, the heart of the plant being just level with the surface of the ground.

### CULTIVATION.

As soon as the plants have struck, the work of cultivation should commence, first by hand hoeing round the plants without cutting or disturbing the roots, and then cultivating between the rows with a Planet Junior or other single horse cultivator to break and loosen the soil to form a mulch to prevent evaporation of moisture.

It is of considerable importance that the plant be kept growing from the time it is set out in the field, and this can be greatly assisted by continuous cultivation. As the season advances it will not be possible to cultivate as deeply as the early cultivations on account of the danger of injuring the roots.

### TOPPING AND SUCKERING.

As soon as the flower buds appear at the top of the plant, they should be cut out. This operation, which is known as topping, will commence about ten weeks after planting out. The average number of leaves left after topping will be ten or twelve, some more and some less, according to whether the plant is showing vigorous growth, or otherwise. A vigorous plant topped too low will produce a coarse leaf with a prominent mid-rib, which is undesirable.

Topping will cause the plants to branch out from where the leaves join the stem. These shoots have to be removed by breaking them sideways with a finger and thumb before they reach three inches in length. The crop will have to be gone through two or three times between topping and harvesting to remove the side shoots or suckers, as they appear. Both topping and suckering are important operations, and can only be neglected or delayed at the sacrifice of quality in the leaf.

To obtain the bright coloured good smoking leaf required by the manufacturer, not only must the right soil, fertilisers and varieties be used and the plants kept growing without a check, but the leaf must be harvested at the right stage of maturity.

### INDICATIONS OF MATURITY.

As the leaf matures it loses its smooth appearance and becomes roughened and brittle, increases in thickness or body, and if folded between the finger and thumb will split. The green colour of the young growing leaf changes to a lighter shade and is flecked with yellow. These are all indications of maturity.

Harvesting will commence from two to five weeks after topping according to the soil and season.

The bright yellow colour indicating full ripeness will show at the tips, and if the leaf is left on the plant long enough will spread over the surface to the butt end. Before this occurs, however, the first part of the leaf to colour will have darkened and started to decay. The leaf is, therefore, picked somewhat before the stage of full ripeness, and maturity hastened and evened up artificially in the curing barn.

### HARVESTING.

The leaves of the tobacco plant do not mature simultaneously but progressively from the bottom upwards, and as it is important for successful curing to have the barn filled with leaf of uniform maturity, the method of harvesting is to strip the leaves off the plant as soon as they are ready.

Four or five pickings will generally be necessary to complete the harvest, and the intervals between pickings will be from 7-14 days according to conditions. Harvesting and curing, therefore, are practically a continuous process from the time the lower leaves mature until the top leaves are finally stripped from the plant.

The average plant at each picking will yield from 2-3 mature leaves or more, which are broken off by hand and carefully handled so as to avoid breaking or bruising them.

A simple method of collecting the leaves is to strip them off intoessian squares or bags cut open, placed at convenient points in the field. These can then be folded over, pinned together at the corners, and carted without delay to the stringing-on shed.

Harvesting should not be carried out immediately after rain or while the leaves are wet with dew.

Each picking must be completed and the leaves placed in the curing barn in one day, and for that reason this operation calls for the employment of additional labour.

### STRINGING ON.

The harvested leaf must be protected from the sun; therefore, the work of attaching the leaf to the hang sticks is carried out under cover, which usually consists of a lean-to roof against the curing barn, provided with a bench to which the leaf is carted from the field.

The hang sticks are made of 1in. x 1½in. timber 4ft. 6in. long, so as to enable them to rest on the tier poles which are placed at 4ft. centres in the barn. One method of attaching the leaf is to string it on to alternate sides of the hang stick in bunches of three and four leaves.

A piece of string twice the length of the hang stick being folded double, is attached to the middle of the stick. A bunch of leaves is then held in position alongside the middle of the stick and a single piece (strand) of the string passed round the butts and brought diagonally across to the other side and round the next bunch of leaves similarly held and so on, working backwards and forwards across the stick from the middle towards the operator.

The leaves are tied about 1in. from the butts and the string finally fixed by drawing it into a split in the end of the stick, which is then reversed and the same procedure carried out from the other end.

The method recommended, however, is to attach the leaves by wire. At 8in. intervals pieces of ordinary fencing wire about 18in. long are bent around and stapled to the stick so as to provide points 5in. or 6in. long at right angles to it.

The leaf is placed on a bench with the butts towards the operator, who threads five or six leaves on to each point through the midrib about 1in. from where it is broken off the plant, the leaves being threaded on alternately back



to back and face to face with the thickness of a finger allowed between each. The hang sticks must be held in position during this operation, and notches are provided for the purpose on the edge of the bench and on posts let into the ground 4ft. away. As soon as the leaf is attached, the hang stick is placed in the barn.

### THE CURING BARN.

The flue curing process requires varying temperatures and humidity. The curing barn must, therefore, be provided with a heating apparatus and be air-tight. Ventilators both top and bottom are also essential, as the circulation of air is necessary at certain stages.

The width of the building must be a multiple of 4ft., so as to fit in the hang sticks. These rest on tier poles placed through the structure at 4ft. centres apart horizontally and 2ft. vertically, the lowest tier being placed 8ft. above the floor. The length of the building parallel with the tier poles is not so important as the width, but it is usual to build the barn square.

Curing barns have been built of brick, wood, fibrolite, and galvanised iron. However, the cost will be the main consideration in the material used.

The illustrations give details for constructing a standard size barn 16ft. x 16ft. and five tiers high built of fibrolite—the blocks being supplied by James Hardie and Co., Ltd., Rivervale. A barn this size will be required for each five acres.

Larger barns are not recommended as the cure would be less uniform and they would be more difficult to fill in the one day.

Cheaper flues could be made of 20 or 22 gauge iron. A three-foot wide sheet will make an 11in diameter flue, which is connected up in short lengths like a stove pipe. The life of such a flue would, of course, be much shorter than that shown in the illustration, but it would be much cheaper.

The flues require to be given a gradual rise of 2ft. from where they enter the barn from the furnace at floor level to where they go through the wall to connect with the smoke stacks outside. They should not be placed nearer than 18in. to the walls of the building on account of the danger of fire.

Fire bricks are necessary for the furnaces, and it will be noticed that 9in. ordinary brickwork is carried up 4ft. at the furnace end of the barn. This is also necessary on account of the danger of fire. It is recommended that the floor be made of concrete.

The top ventilation can be improved by having the ridging so arranged as to be able to raise it above the tip of the roof so that ventilation is provided the whole width of the building. The vents must, however, fit closely so that the barn is as air-tight as possible when they are closed.

It is estimated that a fibrolite barn would cost from £80 to £90.

A wet and dry bulb thermometer (Psychrometer) will be required in the barn to determine the humidity and temperature. The method of making this is described by Mr. G. E. Marks in his formula for curing cigarette leaf, given later on.

It is often necessary to put moisture into the barn to get the humidity required at the commencement of curing. Steam generated from a 5-gallon petrol drum and conveyed from it to the barn through a piece of hose will be found most useful in this connection.

### CURING.

This process is the most important operation in the production of good leaf for market and requires judgment, knowledge and care, in the absence of which experience may be very dearly bought.

As the trade requires a bright coloured flue cured leaf, it is necessary for growers to supply this, otherwise the growing of the crop, except as an experiment, should be left alone.

Failure is bound to result if conditions are unsuitable. On the other hand, it is a simple matter to ruin the leaf in the curing barn even if a first class leaf has been harvested. It is not possible to lay down a hard and fast formula for curing all tobacco, and the curer must use his judgment in making modification as the necessity arises.

There are three stages in the process, known as (1) Yellowing the leaf, (2) Fixing the colour, and (3) Drying out the midribs and stems.

Yellowing takes place while the leaf is still living and requires from 24-36 hours. At temperatures above 120deg. F. the leaf is quickly killed, so this point must not be passed during the first stage.

As soon as the barn is filled, the psychrometer is hung in the centre among the leaves of the bottom tier; vents and door closed and fires lit. The curing is started at 80deg. F. or 90deg. F., and the first stage should be completed at 110deg. F. or 120deg. F.

The leaf must not be dried too quickly at the beginning, but as it colours up the humidity of the barn must be reduced by slowly raising the temperature and gradually increasing the ventilation.

The next stage, "Fixing the colour," is the critical part of the cure, the object being to remove the moisture as fast as it is given off by the leaf. If the leaf contains very much moisture, when the yellowing has been completed, patches of red or brown will appear on the surface of the leaf. This trouble, known as sponging, is caused by insufficient ventilation towards the end of yellowing. More ventilation may prove beneficial, but it is often too late to correct the trouble at this stage.

If the heat is increased too rapidly while the leaf is full of sap, scorching will result. The temperature should be gradually increased throughout this stage of the curing until 130deg. to 135deg. F. and kept at from 130deg. to 140deg. F. until the web of the leaf is completely dried out, which will be from 10-18 hours after the completion of the yellowing process.

The critical stage is now past and the last stage is simply a matter of drying out the midribs and stems. The ventilators are nearly closed and the temperature raised 5deg. per hour to 170deg. F. and held until the stems are completely dried out.

### FORMULA FOR CIGARETTE LEAF.

Gradually raise temperature to 95deg. in six (6) hours, remain at this point for three (3) hours, then cease firing, and allow temperature to drop back to about 90deg. and remain at this temperature until the leaf has attained a light pea green colour or is about half yellow. This usually takes about 20 or 30 hours from the start point, and for the whole of this 20 to 30 hours the atmosphere should be kept as nearly saturated with water vapour as possible. This can be done by applying water freely to the floor and pipes. A psychrometer is necessary to ascertain the degree of humidity required.

When the leaf has attained the half yellow colour, advance the temperature  $2\frac{1}{2}$ deg. an hour to 100deg., then open ventilators in roof about three inches, also slightly open bottom vents and continue to raise the heat to 110deg. in four (4) hours. When this degree is reached open all of the ventilators wide both in roof and at floor level and let them remain thus until the web of the leaf is dry, remain at 110deg. for eight hours, then at this stage the tips of the leaf should be commencing to curl up bright; if not, remain at 110deg. until this takes place. Then carry the heat up to 115deg. in two hours, remain there for eight hours, then advance to 120deg. in two hours, stand at this temperature until the web of the leaf is almost dry, then continue to 125deg., where the drying of the web of the leaf is completed. Now half close the vents and raise the heat at the rate of 5deg. per hour until 170deg. is reached. The heat is often taken higher, 180deg. if required, to dry stems which should be quite brittle enough to snap when bent. Close vents for last few hours of drying.

The main points to be observed in the curing process are:—

Moist atmosphere during the yellowing. Plenty of ventilation after 110deg. is reached in the drying. There should be no sweating allowed at this stage, as it causes sponging. Reddening is caused by too severe heat, and is suppressed by reducing temperature 10deg., then gradually raising about 2deg. an hour until the former temperature is reached, then proceed as specified in formula.

#### AVOID THE FOLLOWING POINTS.

Do not harvest tobacco directly after a rainy spell; it is advisable to wait at least a couple of days if possible, to allow the replenishing of gum on the leaves and also the reduction of some of the surplus sap accumulated.

#### HOW TO MAKE A PSYCHROMETER.

Take two thermometers and fix them side by side on a piece of board. To the bulb of one of these fasten a strip of thin muslin, one thickness tight around the bulb and secure to same at top and bottom by tying with thread. Cut this wick off about three inches below the bulb, wet the whole and allow about one inch to penetrate and remain in a cup of clean water. The water from the cup is drawn upwards through the wick to the bulb, thus this bulb is being kept constantly moist, while that of the other thermometer is dry. The water on the surface of this wet bulb will evaporate into the air about it more or less rapidly according to the dryness of the atmosphere surrounding it. The more moisture the air contains, and less rapid will be the evaporation and *vice versa*. When the two thermometers register alike the atmosphere is said to be saturated and no evaporation takes place. It is desired to keep as near saturation as possible during the yellowing process, but a difference of 3-4 degrees is permissible. It is important that the thermometer or psychrometer should be hung among the tobacco where a true registration of heat and moisture can be recorded; proper degrees of heat, light and dryness of atmosphere are the fundamental principles essential in drying good tobacco.

#### BULKING AND HANDLING.

After the stems are thoroughly dried out as mentioned above, all doors and ventilators should be opened wide to allow the tobacco and barn to cool down. The flues may be covered with wet bags and the still warm floor thoroughly wetted, the aim being to make the atmosphere moist. In a saturated atmosphere tobacco

will come into order in a couple of hours, on an average, and it should then be taken down and bulked.

Too much moisture in the leaf tends to darken it, and also makes favourable conditions for mould; it is essential, therefore, that the leaf should not remain in a moist atmosphere too long.

It should be bulked just before it is soft with a slight crackling in the lateral veins when squeezed in the hand; at the same time the midribs should be brittle enough to break when bent about one-half their length.

Tobacco should not be bulked on or nearer than one foot of the ground, as it absorbs moisture readily and will soon go mouldy. It is a good plan to make a bench of boards with air space underneath.

To bulk tobacco it is usual to lay two rows of leaf with butts outwards, allowing the points of the leaves to lap about one-third of their length. The bulk may be made to any convenient length and height.

After each lot is bulked it should be covered thoroughly with rugs or bags and weighed down tight to prevent drying; it should also be examined every few days to note if heat generates, and if the temperature rises above 80deg. F., the whole should be turned.

After the leaf has been in bulk for six weeks, it is ready for grading and packing for market. The leaf is graded according to colour, texture, and size, the colour grades being—lemon, orange, bright mahogany, mahogany, and dark.

If the leaf from each cure has been kept separate in the bulk, the texture will be fairly uniform in each lot and the grading will chiefly be a matter of colour and size. The graded leaves are tied into bundles or "hands" by wrapping a leaf around the butt ends, the tie being made by pulling the end of the tie leaf through the "hand," a sufficient number of leaves being put into each bundle to make the butt of the "hand" approximately one inch in diameter.

The leaf is then baled under pressure, the weight of a bale being from 150-200 lbs.

#### *Acknowledgments:*

Garner, W. A., "Tobacco Curing," Farmers' Bulletin, No. 523. U.S.A.

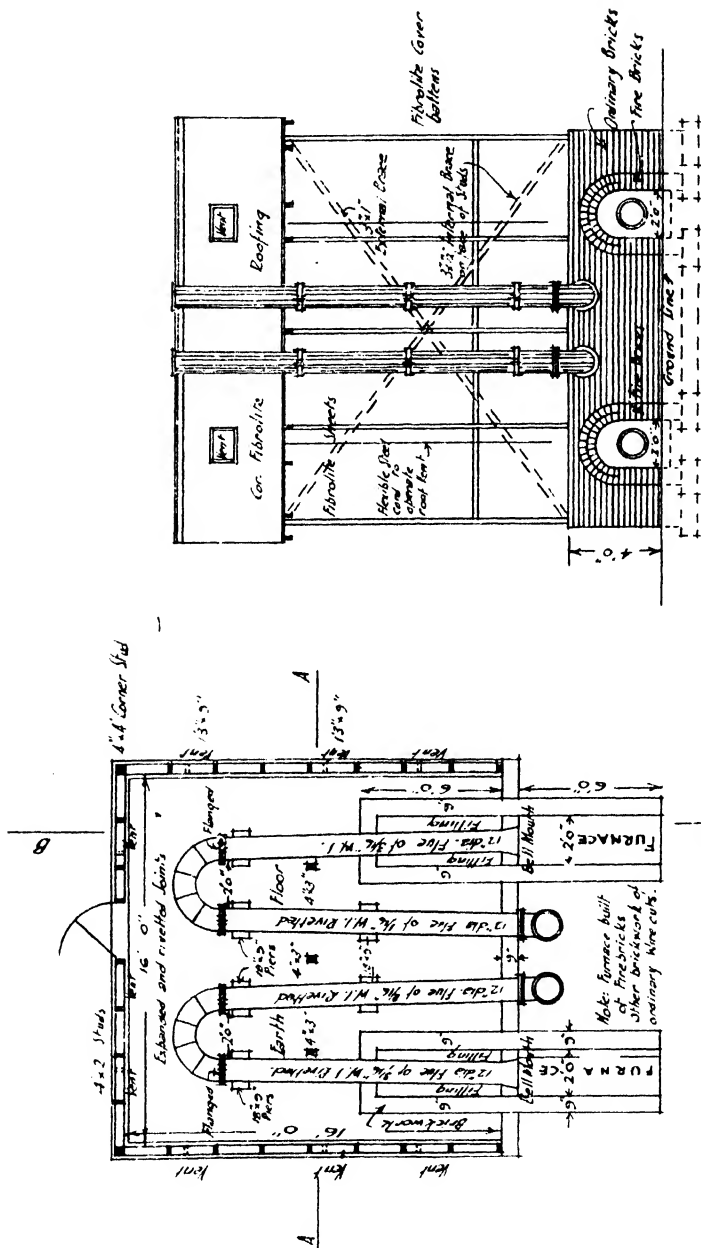
Killebrew, J. B., and H. Myrick, "Tobacco Leaf."

Marks, G. E., "Production and Flue-curing of Tobacco." Bulletin 53, Victorian Dept. of Agric.

Smith, Temple, A. J., "Tobacco Culture." Bulletin 53, Victorian Dept. of Agric.

*Note.*—As tobacco is an excisable commodity, it is necessary for intending growers to keep certain prescribed records, and to be registered as producers. Application must be made to the Collector of Customs, Perth, from whom the necessary forms may be obtained. No fees are payable in this connection but, unless this regulation is complied with, growers are liable to a penalty of £20.

· FIBROLITE · TOBACCO · CURING · BARN ·



GROUND PLAN.      SIDE ELEVATION.  
Scale:- One Inch = 8 Feet.



## BRAXY-LIKE DISEASE OF SHEEP IN WESTERN AUSTRALIA.

By H. W. BENNETTS, M.V.Sc.

The following report deals with co-operative investigations which are being carried out by the Western Australian Department of Agriculture and the Council for Scientific and Industrial Research.

Braxy-like disease itself is a trouble which mainly occurs in Western Australia, but the causal organism is not confined to this State. In consequence all sheep owners, and particularly those who graze their flocks on rich pastures for long periods, may find much of interest to them in this report.

A brief note dealing with the progress of the investigation into this disease was given in a previous issue of the C.S.I.R. Journal (Vol. 2, pp. 109, 246, 1929). Since that time, however, the cause of the disease has been definitely established and some methods of control introduced.

The Western Australian braxy-like disease is an acute infectious disease of sheep. It is characterised by a fatal termination, frequently without premonitory symptoms. Fat animals chiefly are attacked, and putrefaction after death is rapid. There are, however, no very characteristic post-mortem changes in fresh carcasses, such changes as are seen being simply the evidences of toxæmia or general poisoning. The most characteristic feature is the presence in the small bowel contents of very large numbers of a micro-organism closely allied to the *Bacillus Welchii*, and for which the definite and specific name *Bacillus oritoricus* is herewith adopted. The above characteristics of the disease have led us to adopt the descriptive scientific name "infectious entero-toxæmia." The disease has a definite seasonal occurrence (April to October), and is confined to cultivated, and particularly to well-improved, areas. It does not occur on "bush" lands, and the incidence may be checked by transferring affected flocks to uncultivated pastures.

### 1.—HISTORY.

The disease evidently appeared first in the Beverley-York district about the year 1915, its appearance being said to have been preceded by a period of increased agricultural activity in this area. Although, as far as can be ascertained, only one or two properties were affected in 1915, the disease soon spread over a wide area, and began to assume serious proportions.

No systematic investigation was made until 1918, when the services of Professor Dakin of the University of Western Australia were made available. He described the symptoms and post mortem appearances, and finally gave the opinion that the disease was probably of bacterial origin. Recognising the superficial resemblance of the disease to braxy, and to the braxy-like diseases of the Eastern States, he designated the Western Australian condition as a "braxy-like disease."

It has been shown by the writer that the local disease is quite distinct from true braxy (of Europe) and from black disease of the Eastern States. Bull\* has described a disease affecting sheep in South Australia, which is most probably identical with the Western Australian disease.

\* Bull, L. B.—Aust. Assoc. Adv. Sci. Report 17: 715, 1924.

In 1902, and subsequently,\* and again in 1910,† Gilruth described a somewhat similar braxy type of disease in the South Island of New Zealand affecting hoggets fattened on turnips, and recently expressed the opinion that it is most probably the same as that occurring in this State.

In the light of recent knowledge, Dakin's name "braxy-like disease" is to be deplored, because of the confusion its use may occasion. Nevertheless, in view of its universal acceptance in this State the term is retained for the Western Australian condition and is here used in that restricted sense.

In 1925, the writer was appointed the first Veterinary Pathologist to the Department of Agriculture of Western Australia, and commenced an investigation of the disease. In 1928 he was seconded to the Council for Scientific and Industrial Research, and since then has devoted practically the whole of his attention to this problem. The Council has provided increased facilities and assistance for the investigation.

## 2.—DISTRIBUTION AND ECONOMIC IMPORTANCE.

Originally confined within a small radius, the disease has spread over a large area of country extending from Three Springs in the north to Gnowangerup, Tambellup, and Bridgetown in the south; a distance of roughly 380 miles. It has also spread in an easterly and westerly direction, following the lines of settlement, and has been reported along the Eastern Goldfields line as far as Merredin. The heaviest losses, however, have been experienced in the Great Southern district.

The disease, not being a notifiable one, it is impossible to determine the economic loss even approximately, but at a conservative estimate, it must run into hundreds of thousands of pounds sterling annually.

## 3.—INCIDENCE.

The mortality varies considerably from year to year as regards both districts and individual properties, the variation being from less than 1.0 per cent. to 29 per cent. of the flock.

The disease has a definite seasonal occurrence, and follows the appearance of green feed after the first rains. With early (February-March) rains it may appear in April. Deaths occur spasmodically until late October, when the feed has normally dried up. It is definitely associated with green feed, although small losses due to braxy-like disease do sometimes occur when sheep are feeding on ripened peas during the summer months.

The annual variation in incidence would appear to depend on two main factors, namely, cultivation and naturally acquired immunity.

(i) *Cultivation*.—The occurrence is definitely related to cultivation and pasture improvement. In the absence of cultivation there is practically no permanent pasture in the affected areas apart from natural herbage with a low-carrying capacity. During the winter months sheep are largely depastured on green crops (oats, rape, wheat, etc.) or on weeds which grow in cultivated paddocks. Paddocks left uncultivated and untreated with phosphates carry little forage. Improved pastures, consisting mainly of clovers, have been established (in small areas) with the assistance of superphosphate top dressing. The carrying capacity of cultivated

\* Gilruth, J. A.—New Zealand Department of Agriculture, Annual Reports.

† Gilruth, J. A.—Aust. Assoc. Adv. Sci. Report 13: 567, 1910.



and improved country is from half a sheep to two sheep per acre. The disease has become an almost inevitable sequel to cultivation and pasture improvement in certain districts, and frequently the incidence seems to be directly related to the degree of improvement. It is constantly appearing in new localities following the opening up and improvement of country.

(ii) *Naturally acquired flock immunity*.—Records kept over a number of years show that on properties in districts where the disease has been known for a number of years, the death rate due to braxy-like disease almost invariably shows a steady decline. Usually, within about five or six years, the mortality rate in flocks which are bred on these properties ultimately becomes less than one per cent. or may disappear entirely. The heaviest losses are generally experienced in flocks which are imported into affected districts from localities where the disease is unknown, or in flocks in districts where it has just recently made its appearance.

Sheepowners who have experienced a decrease of mortality are always ready to admit that this is not due to any change in conditions or to any attempted methods of control. Apart from the beneficial effect of changing to unimproved ("scrub") country where available, they have found no effective method of arresting the course of the disease except perhaps starvation, which they do not favour. The only satisfactory explanation of the gradual decrease is that flocks gradually acquire a natural immunity.

When the disease first makes its appearance in a flock, the heaviest losses occur in the grown sheep of all ages; in subsequent years the percentage of total mortality experienced becomes progressively greater among lambs 2-4 months old, and smaller in the older animals. It appears that most of these older animals which survive have been affected with the disease to some degree, and acquired an immunity. This immunity is apparently strengthened by the continuous exposure to infection, and is ultimately handed on to the lambs, probably by means of immune bodies in the milk. Mason Dalling and Gordon\* have shown that ewes immunised with a very closely allied organism the lamb dysentery bacillus, do actually eliminate, in the cholostrum or first milk, immune bodies which protect the sucking lamb from lamb dysentery.

(iii) *Other factors*.—Of other factors influencing the incidence, the condition of the sheep is the most important. Chiefly sheep in good condition are affected, and particularly rapidly fattening animals. Sheep, of any age from two months onward, and rams, ewes, and wethers all appear to be equally susceptible. All breeds are evidently susceptible, the disease having been encountered in Merinos, Border Leicester, Romneys, Comebacks, and various crossbreeds.

#### 4.—SYMPTOMS.

The period between the onset of recognisable symptoms and death is very short, the great majority of sheep being merely found dead, usually near the camp and in the morning. Consequently great difficulty has been experienced in obtaining suitable subjects for clinical and pathological examination. Sheep occasionally show symptoms after driving, as in changing pasture, yarding, etc., and dead sheep are very often found on the morning following a change over to fresh pasture.

Two types of symptoms have been noted:—

(i) *Comatose, or quiet, type*.—The affected animal at first appears restless and excited. It moves about with nose to the ground, chewing dirt, sticks etc. The gait becomes staggering and soon the sheep lies down, usually on its side with its

\* Jour. Path. and Bact. 33 : 783, 1930.

head turned to the left flank. It rapidly becomes unconscious, and the breathing is hurried and irregular. Death is quiet, generally within three to four hours after the first signs of illness, but in rare cases it may be delayed for about 24 hours.

(ii) *Convulsive type*.—An animal, apparently only slightly dull, is suddenly seized with convulsions. It lies stretched out on one side with head turned back and continuously exhibits more or less violent “galloping” movements associated with twitching of muscles, etc. Death usually occurs within two to four hours.

### 5.—PATHOLOGY.

During the course of the investigation it has been possible to make careful post mortem examinations of 30 sheep dead of typical braxy-like disease, the animals being either killed when symptoms definitely indicated the nature of the disease, or being allowed to die. In all these cases the examination was made immediately after death. In no case has there been any indication of the characteristic abnormalities seen in true braxy or in black disease.

The changes seen in fresh carcasses are very slight:—The mesentery and bowel walls are injected with blood, the liver is somewhat soft and frequently somewhat congested; the kidneys are congested, and the heart usually shows pronounced subendocardial haemorrhages. Internal parasites are rare or occur only in small numbers. Fluke is unknown in Western Australia. Microscopic examination of organs, liver and kidney particularly, shows evidence of changes usually associated with the circulation of a toxin or poison. All the available facts pointed to the disease being most probably of bacterial origin. In the fresh cases examined, however, there was no evidence of bacterial invasion of any of the body tissues.

### 6.—BACTERIOLOGY.

(i) *General*.—In ten cases attempts were made to cultivate bacteria from various situations, namely, the liver, bile, spleen, kidneys, heart, blood, etc. Post mortem examinations were made with careful aseptic precautions, and tubes of various types of culture media were sown with the above materials. In only two cases was any germ isolated which could be regarded as a possible cause, and that was a bacterium, subsequently found to be the causal organism—*Bacillus ovitoricus*.

*B. ovitoricus* is a microscopic, rod-like organism or bacillus, which is able to develop spores and thus persist for long periods in soil, etc. The bacillus belongs to the anaerobic group which grows only in the absence of free oxygen. It can be readily cultivated artificially. It was at first thought to be *B. Welchii*, an organism which was one of the main causes of gas gangrene in soldiers during the war, but by means of a highly technical test it has been possible to demonstrate that it is really an entirely new organism.

It appeared that the disease was not due to direct invasion of the blood or body tissues by any bacterium, although there was already some evidence that this *B. Welchii* type of organism might be operating from the bowel. It was therefore decided to investigate the bacterial flora of the bowel contents, particularly as Bull (loc. cit.) had demonstrated the proliferation of *B. Welchii* in the bowel contents of sheep affected with a similar disease in South Australia.

(ii) *Investigations of stomach and bowel contents*.—Material from different levels in the gastro-intestinal tract was microscopically examined. As a result it was shown that an outstanding and constant feature in 18 cases of braxy-like disease was the presence of large numbers of *B. ovitoricus* in the contents of the

small intestine. In the bowels of normal sheep and of sheep dying from diseases definitely other than braxy-like disease, the presence of this bacillus could not be demonstrated microscopically..

Associated with the prolific growth of this specific germ in the bowel contents is a potent toxin. If small bowel contents (fresh or preserved with 0.5 per cent. chloroform for 24-48 hours) of normal sheep are passed through a bacterial filter, which removes all germs, comparatively large doses can be inoculated into mice or guinea pigs without any ill effects. On the contrary, similar germ-free filtrates of bowel contents of sheep dying from braxy-like disease are very toxic for these animals, and even for sheep. Amounts as low as 0.002 c.c. have been shown on inoculation to be fatal for mice and 0.45 c.c. for guinea pigs.

That this toxicity is due to the elaboration of a toxin by the rapidly multiplying *B. oritoxicus* is shown by the fact that experimental animals can invariably be protected by the use of the antitoxin of this bacillus. Mice and guinea pigs inoculated with suitable amounts of mixtures of bowel filtrate, from cases of braxy-like disease, and with *B. oritoxicus* antitoxin remain normal, whereas similar animals inoculated with the same (or smaller) amount of bowel filtrate without admixture of antitoxin invariably succumb. The properties of the bowel filtrates from affected sheep have also been shown to be identical with the toxin produced by *B. oritoxicus* in artificial culture medium (horse-muscle broth).

We arrive at the point then that a prolific growth in the small bowel contents of the *B. oritoxicus*, with the production of a potent toxin by it is a constant feature of braxy-like disease, and of no other disease of sheep investigated.

## 7.—EXPERIMENTAL PRODUCTION OF THE DISEASE.

(i) *Inoculation experiments.*—Guinea pigs, and susceptible sheep (bred outside the area where braxy-like disease is known to exist) were inoculated with blood from affected sheep. One guinea pig inoculated with 10 c.c. of blood died from a *B. oritoxicus* infection, but apart from this, all experiments were attended with negative results.

One experimental sheep inoculated with germ-free filtrate of the bowel contents of an affected sheep, and two sheep inoculated with culture toxin of the *B. oritoxicus* died within about 24 hours from what closely resembled naturally occurring braxy-like disease both in symptoms and pathology.

(ii) *Drenching experiments.*—All evidence indicated that the natural method of infection was by the mouth, field observations having proved the important bearing of certain dietetic conditions on the incidence of the disease. There was never any evidence of the introduction of infection through wounds, and nothing suggested the operation of any insect transmitter.

Attempts to produce the disease in susceptible experimental sheep, by drenching them with stomach and bowel contents from affected sheep and with cultures of the bacillus, were all attended with negative results. Sheep were stall fed on types of diet which, it had been noted, tended to favour the appearance of the disease in the field, and over long periods were given doses of cultures daily. Sheep running on pastures, which were known to be "dangerous" were drenched in the field with cultures. Always the results were negative.

It was postulated that the reason for the negative results obtained might be due to the fact that the acid in the stomach destroyed the bulk of the bacteria before the more favourable small bowel situation was reached. Accordingly, sheep

were treated so as to diminish the acid content of the stomach and given drenches of culture. Still negative results were obtained.

Recently however, it has been found possible to bring about the desired result. Williams\* had shown that when the small bowel of the human subject becomes obstructed, there is frequently a prolific growth of *B. Welchii* in its contents followed by the development of a *B. Welchii* toxæmia, and it appeared that somewhat similar conditions might favour the growth of the closely allied *B. ovitoricus* in sheep bowel contents.

By the use of belladonna, which generally depresses the secretion of stomach acid, and opium (at the suggestion of Dr. Gilruth) which slows the movement of the bowel, followed by cultures of *B. ovitoricus*, we have successfully reproduced braxy-like disease in four experimental sheep. The drugs have been given by the mouth in milk (which apparently acts as a vehicle to carry them direct to the fourth stomach instead of only to the rumen, Westert†), and were followed by cultures similarly administered. The experimental disease resulting therefrom resembles the naturally occurring one in all particulars, symptoms, pathology, bacteriology, etc. Symptoms have occurred as early as nine hours after the commencement of the experiment. Some sheep, however, appear to have a natural resistance to the disease, and cannot be infected by this experimental method (two out of six sheep have proved resistant).

#### 8.—THE CAUSE OF THE DISEASE.

As a result of these investigations it is claimed that the braxy-like disease of sheep in Western Australia is due to the proliferation of *B. ovitoricus* in the small intestine contents of affected animals with the production of a highly potent toxin and its absorption into the blood stream.

##### (i) *Predisposing Factors.*—

As previously pointed out, there are certain factors which favour the appearance of the disease:—

(a) *Cultivation and pasture improvement.*—It is well known that the anaerobic group of bacteria, primarily soil germs, to which *B. ovitoricus* belongs, much prefer cultivated land, and are more numerous there than in uncultivated soils. It has been claimed that richness of soils in soluble lime and phosphate increases the virulence or disease-producing power of this group of germs. If so, it would explain to some extent the association of the disease with the use of superphosphate.

(b) *Bowel sluggishness.*—Both experimental and field observations indicated that this is an important predisposing factor. The main stimulants to bowel action in ruminants are fibre and exercise. Braxy-like disease is almost always associated with the minimising of these factors, the animals affected being fat sheep in sluggish condition and taking little exercise on abundant luscious green pasture rich in moisture and poor in fibre content. Losses have been found to occur also when sheep are feeding on ripe peas (pods and seeds) in summer and subsisting almost entirely on the dry seeds picked up from the soil—a concentrated ration without much fibre.

Certain owners claim that compulsory daily exercise reduces the mortality. There is also evidence that a supplement of dry feed (rich in fibre) has a bene-

\* Brit. Jour. Surgerv. 14 : 295, 1926.

† Vet. Jour. 86: 401, 1930.

ficial effect in reducing the incidence. The preventive effect of "scrub" country is probably due in part to its high fibre content and the necessity for greater muscular exercise.

(c) *Injury to the small bowel.*—As might be expected, this exerts a favouring influence on the growth of the bacillus, but the action of this factor has only rarely been demonstrated. Usually the lining of the small bowel shows no injury except for changes (congestion and haemorrhage) occasioned by the action of the toxin produced. Occasionally, however, the injury inflicted by the barbed hairs of the pappus attached to the seeds of *Inula graveolens* (stinkwort) is followed by the proliferation of *B. oritoxicus* in the bowel contents, with the result that a condition resembling braxy-like disease develops. In such cases which have come under notice, the lining of the bowels (large and small) has presented a more or less dense feltwork of stinkwort hairs penetrating more or less deeply into the bowel wall. Judging from information supplied by officers of the Stock Department in South Australia, in which State deaths in sheep are often ascribed by stockowners to poisoning by stinkwort, it seems probable that the so-called stinkwort poisoning as seen in that State is due to braxy-like disease of the Western Australian type. The fact that feeding tests carried out in South Australia have failed to demonstrate any toxicity in the plant supports this opinion.

(d) *Biochemical factors.*—The hypothesis of a special biochemical condition of the bowel favouring the growth of the bacillus does not appear to be tenable, because the disease occurs on a fairly wide range of pastures with different chemical compositions; the germ can be cultivated in the small bowel contents of animals fed on quite different classes of feed; and the disease may be experimentally produced in sheep feeding on dry fodder (in which it does not naturally occur), provided that a sluggish condition of the bowel is produced.

(e) *Close grazing.*—Outbreaks in sheep feeding close to the ground and apparently ingesting a large amount of heavily contaminated soil have been investigated. In these cases, even sheep in store condition are affected, and then the important factor appears to be a massive infection with the *B. oritoxicus* from ingestion of soil.

#### (ii) *General Conclusions.*—

From our observations and experiments, the sequence of events in an outbreak of Western Australian braxy-like disease on a property is as follows:—

The soil has been improved by cultivation and the application of phosphatic fertilisers, resulting in increased carrying capacity through the growth of more nutritious feed. *B. oritoxicus* is introduced to the property by animals carrying it as an innocuous inhabitant of the large bowel. The improved soil has, partly through the fertilisers direct, and partly through the sheep's droppings, become more favourable than virgin soil for the multiplication therein of the bacillus. Numbers of bacilli may be ingested from time to time by grazing sheep. When feed is comparatively scarce or non-succulent, no harm results: the organisms are either destroyed by the stomach secretions or pass rapidly through the small intestine to the large, where they increase but slowly, if at all, and with no ill effects. When, however, the feed is rich and succulent with little fibre or cellulose and the sheep is putting on condition fairly rapidly, taking the minimum of exercise, the normal movements of the small intestine diminish materially, consequently the bacillus on reaching that bowel multiplies enormously, liberating its deadly toxin or poison, which being rapidly absorbed into the blood stream produces the symptoms followed by early death so characteristic of the disease.

## 9.—IMMUNITY-VACCINATION.

(i) *Naturally acquired immunity*.—The evidence for the assumption of a naturally acquired flock immunity has already been discussed. It is hoped in the near future to give a direct proof of the claims in this regard.

(ii) *Artificial immunity—vaccination*.—The evidence of a naturally developed immunity and the successful results which have attended the use of “anaculture” of a closely related organism (the lamb dysentery bacillus), lent encouragement to an investigation into the value of a similar type of vaccine prepared from *B. ovi-toxicus*.

(a) *Preparation of vaccine*.—The organism is grown for 24 hours at body temperature in horse-muscle broth, containing 0.1 per cent. glucose and fresh pigeon muscle. The toxin content is then determined by inoculating mice with small amounts of germ-free filtrate of the culture. To the bulk, 0.5 per cent. formalin solution is added. The formalised culture is then bottled, tightly stoppered, and incubated at body temperature for 10-15 days. The formalin destroys all the bacteria and converts the toxin into anatoxin, a substance which is no longer poisonous, but is strongly antigenic, or effective as a producer of immunity. The vaccine or anaculture is incubated until the process is complete, the harmlessness of the product being tested by inoculating guinea pigs at regular intervals until they tolerate a 10 c.c. dose without any ill effect. The completed product thus contains dead bacteria and anatoxin. Before issue for use in the field, the vaccine is further tested for innocuity by inoculating sheep subcutaneously with 20-30 c.c.

(b) *Laboratory tests with anaculture*.—The vaccine has been tested on guinea pigs in the laboratory, but results have been disappointing with these animals, very little protection being conferred against subsequent infection with *B. ovi-toxicus*.

Sheep were inoculated with 5 c.c. of anaculture, and three weeks later with a further 10 c.c. In a month's time they were then tested in two ways. Four vaccinated sheep resisted the inoculation of amounts of toxin equal to or greater than the quantity which killed each of two unvaccinated control sheep. Four other sheep vaccinated in the same way were tested after the same period of time by drenching with belladonna-opium and cultures of the bacillus. Two unvaccinated control sheep were also dosed similarly. These four vaccinated sheep showed no departure from normal: one control died of typical braxy-like disease within 14 hours of the commencement of the experiment, and the other sheep showed definite symptoms of the disease but recovered.

These results, though not conclusive, are significant.

(c) *Field tests with anaculture*.—In 1930, some 3,000 sheep were inoculated on various properties where the disease had been present in previous years. In every instance, only half of the various mobs were inoculated, and branded, the remaining uninoculated half being run with the inoculated sheep under absolutely identical conditions.

Unfortunately, during last season, the disease only made its appearance on one property where the experiment was being carried out. On this particular place, 923 sheep had been inoculated with vaccine. Only two of these died from braxy-like disease (0.2 per cent.), whereas in the same number of uninoculated animals depastured with them the total loss from the disease was 42 sheep (4.6

per cent.), or twenty times greater. This result is very encouraging, but it is of course realised that further and more extensive tests are necessary before the value of vaccination with anaculture is established. Unfortunately, the incidence of the disease varies so much from year to year that one cannot predict where it may appear during any particular season, consequently large numbers of sheep on numerous properties must be inoculated in order that definite results may be obtained.

Some 10,000 sheep are being inoculated with anaculture at the present time, but the results of this experiment will not be available until a later date.

#### 10.—METHODS OF CONTROL.

As a result of the experimental work already detailed, the following methods of control may be indicated:—

(i) *Preventive inoculation with vaccine.*—The promising results secured by this means have been mentioned. It is hoped that the results of the exhaustive tests which are being carried out in the field this season will definitely demonstrate its value.

(ii) *Feeding of fibre.*—The preventive effect of “scrub country” has been effectively demonstrated. In our opinion, the effects noted are probably due to the high fibre content of the scrub feed as a stimulant to bowel action, thus correcting the stasis which permits the multiplication of *B. ovitoxicus* in the contents of the small intestine. The use of “scrub country” is, however, only of limited value, because the carrying capacity of such land is small, and moreover in the closely settled areas there is very little uncultivated country available for this purpose.

The use of other roughage thus appears to be indicated. Field evidence suggests that supplementary feeding with chaff in automatic feeders is beneficial. Dakin first recommended this practice in 1919, but it was not adopted to any great extent. The disease affecting sheep in New Zealand, which in Dr. Gilruth's opinion is probably identical with the Western Australian braxy-like disease, was checked when sheep had a run-off from turnips (on which the disease mostly occurred) to natural roughage, or were simply provided with straw.

It is suggested that the feeding of chaff, or preferably hay, as often as practicable, say twice a week, or even giving continuous access to straw, would lessen the percentage of mortality. It might, of course, be necessary to yard sheep in order to induce them to eat this dry feed. On one property, the writer has seen sheep eating chaff in preference to the wet green feed in the early morning, and the owner claimed that losses were prevented by this means. In this connection it is interesting to note that several reliable sheep men have found that yarding sheep each night and keeping them in until the pastures have somewhat dried off prevents the occurrence of the disease.

(iii) *Exercise.*—From evidence given in the foregoing, the exercise of sheep as far as practicable is recommended. It is claimed by several sheep farmers that “dogging” sheep around the paddock each morning will prevent the appearance of the disease. One rather hesitates to recommend this procedure, but it provides some practical evidence of the value of exercise as a prophylactic measure. Compulsory exercise should begin before the disease appears, or right at the commencement of the outbreak, otherwise sheep which have the disease in a mild form and might normally recover, may die as a result of this “shaking up.”

(iv) *Avoidance of close grazing.*—Although it is recognised that the best nutritional results are obtained from pasture which is kept close cropped, it may be well to ignore this fact under certain circumstances. Observation has shown that close grazing (with some ingestion of soil by the sheep) is favourable to the occurrence of the disease, particularly where many sheep have died therefrom and have been allowed to rot unburied, resulting in a heavy contamination of soil with the bacillus.

(v) *Disposal of carcasses.*—*B. ovis* rapidly multiplies throughout the carcasses of sheep dead of braxy-like disease, and heavy contamination of the soil may result. All such carcasses should therefore be destroyed before putrefaction is advanced. It has been shown that normal sheep may carry the organism in their bowels, and it is quite probable that animals other than sheep may also be carriers. Therefore the carcasses of all animals dying from any cause should be destroyed. Carcasses are best destroyed by fire: if this is impracticable, they should be buried deeply in an area set aside for this purpose.

(vi) *Prophylactic licks.*—The use of licks containing medicinal substances which will promote small bowel movement is indicated. It is intended to investigate this proposal.

(vii) *Naturally acquired immunity.*—It has not been definitely proved that sheep bred on affected properties eventually develop a naturally acquired immunity to the disease, but there is very strong evidence that such is the case. It appears expedient therefore for sheep-owners in affected districts to avoid, as far as possible, the introduction of sheep from districts where the disease does not occur. It should be the aim to breed from the flock already on the property.

If the vaccine proves effective, new purchases (rams, etc.) should receive preventative inoculations prior to or at least soon after their introduction to affected properties.





## HANDLING WHEAT IN BULK.

### THE REAL ISSUE—WILL IT REDUCE COSTS?

GEO. L. SUTTON, Director of Agriculture.

*Foreword by Hon. J. Lindsay, M.L.A., Minister for Works.*

The following article, prepared by the Director of Agriculture as a member of the Bulk Handling of Wheat Committee, was submitted to the Hon. Minister for Works, Hon. J. Lindsay, M.L.A., who, before making it available for publication, made the following comments:—

"The question of bulk handling of wheat is exercising the minds, not only of the wheat growers of Western Australia, but of those of each of the other exporting States of Australia.

The subject to-day is of more importance than it has been in the past because of the very urgent necessity of finding means of reducing the cost of production under the prevailing low prices.

The information contained in this statement is an important contribution on the subject, and Mr. Sutton is to be commended on its compilation. I hope that it will be studied carefully by all persons concerned, from the point of view of reducing production costs, and not from that of purely sectional interest. Such a reduction, whilst benefiting the wheat growers, would also result in a decided advantage to the people of Australia generally."

As is fairly well known to the older generation of wheat growers, I have been an active protagonist for the "bulk handling" of wheat both before, and since, arriving in this State. My reason for this attitude was that, as the result of a close study of the question, I had arrived at the conclusion that the adoption of "bulk," as compared with bag handling methods, meant a saving of at least 3d. per bushel to the producer.\*

My ambitions in this direction were almost realised during the War period, for, owing to the great losses occurring with bagged wheat during that period, consideration was given to a Commonwealth emergency scheme for storing wheat in bulk in order to avoid the losses referred to. Fortunately the War ended, and, except in New South Wales, the scheme was not proceeded with. As far as bulk handling was concerned this was unfortunate, for had the emergency bulk storage scheme been established it would have inevitably been the forerunner of the general adoption of an Australian scheme for handling wheat in bulk.

Since the War I have ceased to advocate "bulk handling," as I believed the costs of construction and other factors rendered the time inopportune for its consideration. I also believed that it would continue to be inopportune until some unusual and outstanding state of affairs, such as a partial failure of the jute crop, or a strike in the jute mills, focussed public opinion upon the necessity and desirability of a change in our methods of handling and transporting the major crop of Western Australia, as well as of the Commonwealth.

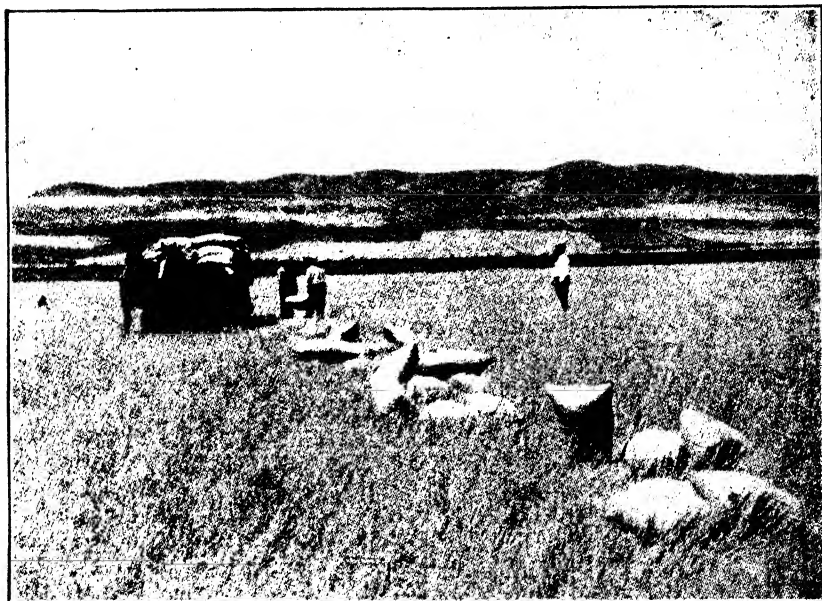
The record low price now obtaining for wheat, and the necessity for exploring every possible avenue for reducing wheat production costs, consequent upon the desperate plight of the farmer, now provides an essential reason for a reconsideration of the bulk handling question. In consequence, I feel the originators

**WHEAT HARVESTING METHODS ON THE PACIFIC COAST, U.S.A.**

*As in Western Australia, the grain is harvested directly from the ripe standing crop.*



At present only forty per cent. of the grain handled in bulk on the farm.



Sixty per cent. of the grain is still handled in bags on the farm, but  
97 per cent. of the total exports are in bulk.

of the proposed scheme for Western Australia are entitled to gratitude for introducing it.

Unfortunately, its introduction, so late in the season, demanding a quick and possibly a hasty decision on a momentous problem of considerable financial magnitude, coupled with the proposal for an acquiring monopoly, which has been construed to mean a marketing monopoly, has led to heated opposition from some quarters. In consequence, the question of bulk handling is not likely to be discussed solely from the viewpoint of its advantages and disadvantages, but rather from a prejudicial standpoint, because of its association with a system of special design, or with projects or policies with which the producers, or even ardent advocates of bulk handling, may not be in accord. This is decidedly undesirable, and a plea is now being made that this matter be discussed dispassionately and as seriously as its importance demands, and having regard only to the one fundamental question that matters—Will it reduce the costs of production and transportation?

Very many estimates have been made to answer this question, but it is not easy to obtain definite information as to actual costs under both systems of handling grain under similar conditions for each. In New South Wales, where both systems have been practised under Australian conditions for several years, comparisons are difficult and complicated by the fact that it was introduced as an emergency storage scheme, and it is generally believed that the capital expenditure involved in connection with the extension of the scheme was unnecessarily high. The scheme is also considered to be somewhat unbalanced.

Some interesting information on the relative costs of handling wheat in bulk and in bags is furnished by a bulletin to hand within the past week from the United States Department of Agriculture; it is entitled "Bulk and Sack Handling of Grain in the Pacific Coast States," and its authors are Messrs. E. N. Bates, Senior Marketing Specialist, and G. P. Bodnar, Associate Marketing Specialist, Grain Division, Bureau of Agricultural Economics, U.S.A., and E. J. Stirniman, formerly Associate Agricultural Engineer, University of California. This bulletin is most valuable, as it is purely an economic study and the investigators are detached from the States concerned and likely to obtain a proper perspective of the position.

The information in the bulletin is of special interest to Western Australia, because the history of wheat development in the States referred to, and the methods of harvesting, are practically identical with those of our own State. The similarity between the history of their wheat belt and ours may be judged from the following opening extract from the bulletin: "The origin and development of the grain producing and marketing industry on the Pacific coast is an interesting story of industrial growth beginning with pioneer conditions and developing into grain production in mammoth proportions, and then gradually giving way to other forms of agriculture as the country developed. When the rush for gold subsided somewhat, thinking men recognised that the agricultural resources of the new country far exceeded its mineral deposits. In the seventies the remarkable discovery was made that by a new method known as dry-land farming phenomenal yields of grain could be produced on the broad, dry inland prairies East of the coast mountains. These great plains were rapidly developed into vast wheat fields. The production of wheat soon exceeded the needs of the Pacific coast population. The wheat export business naturally developed to provide a market for the surplus grain. Conditions in those early days seemed to favour, if not to necessitate, the use of sacks for transporting Pacific coast grain. But changing conditions bring changing needs. The usual absence of rain in

the grain sections of the Pacific coast made it possible to leave grain in bags in the fields and in piles at country shipping points for months after the harvest, unprotected by roofs or covering. In the early days there were few railroads. Much of the grain was moved in wagon; over poor roads to river banks and there loaded on barges for movement to deep-water terminals. There were no grain elevators; therefore, the simplest means of moving the grain was to put it in bags. Grain in bags accommodated itself to almost any form of transportation whether on land or water. Sailing vessels preferred grain in bags for the long voyage around the Horn. In fact, underwriters refused to insure sailing vessels or their cargoes if the grain was in bulk. The use of grain bags was, therefore, of natural growth, and the system became thoroughly entrenched. Conditions that encouraged or necessitated the use of sacks for grain have changed with the years. The size, motive power, and facilities of ships are now favourable to the handling of bulk grain. The Panama Canal has shortened the voyage from the Pacific coast to Europe, and no longer do insurance companies favour grain in bags. This is evidenced by the fact that the wheat exports from the Pacific coast are practically all in bulk at the present time (1930). In the keen competition on the world wheat markets the great factor for success must be *lowered production costs*. Producers on the Pacific coast are in a position to reduce their production costs by handling their grain in bulk from the threshing machine to the terminal markets. Many of the efficient farm managers have been among the first to recognise the possibility of handling their grain more easily, rapidly, and cheaply by the use of the bulk system. The high price of sacks and the high cost of labour during the World War stimulated a strong movement in the Pacific Coast States toward bulk grain on the farms. High construction costs during and after the war, the fact that grain dealers paid differentials in favour of sacked grain, the reduction in the cost of sacks and in the cost of labour after the war, and the sudden fall of the price of grain, retarded construction of country elevators for a time. Construction of terminal elevators for handling grain in bulk at export points, which was stimulated by war conditions, has been continued. The progress that the bulk method of handling grain has made in the Pacific Coast States during the last 10 years is based largely on this terminal elevator construction, which now makes bulk shipments from the country possible."

With the exception of the reference to water transport, it is the history of Western Australia over again. Even the production of wheat is nearly the same; in 1927/28 it reached 44½ million bushels, but in 1929/30 it dropped to 28 millions.

It is pointed out that the facilities for bulk handling having been provided, the quantity of bulk grain exported from Columbia River Markets to foreign countries increased from 1.4 per cent. to 97.3 per cent. of the total exports from those markets during the four-year period 1921-1925, and that in five-year periods since then to 1929/30 the bulk grain exports have not been less than that percentage, and this despite the fact that the receipts in bulk from the farmers have not in any year reached 40 per cent. of the total receipts from them.

It will thus be seen from the experience of these Pacific States that, though it may be desirable, it is not essential for the success of bulk handling for the whole of the crop to be handled in bulk, nor is there any evidence of the need for a monopoly for acquiring wheat. Bulk handling can, therefore, be carried out successfully quite apart from these two features.

Though it is not stated yet, as less than 40 per cent. of the receipts are received in bulk, and more than 97 per cent. exported in bulk, it is apparent that the largest

proportion of the wheat received at the terminals is emptied out of bags and shipped in bulk. This seems to indicate that this practice is due to the influence of one or both of the following factors:—

- (a) The ease and cheapness of handling in bulk; and
- (b) A preference of buyers for bulk wheat.

The investigators discuss first the saving effected on the farm through bulk handling. In this connection the Pacific coast farmer, like the Australian one, enjoys the benefit of a climate which enables him to allow the grain to ripen on the stalk, and then harvest it and thus dispense with the old world methods of reaping and threshing. One of the machines which the Pacific Coast farmer uses is somewhat different from our harvester or header. It is called the "Combine" (short for combined harvester); it is capable of taking a swathe of 20 feet and can deliver the grain either in bags or into a bulk wagon with and alongside the "harvester." The saving from farm to siding is discussed as follows: "Studies conducted on approximately 45,000 acres of grain land in California in the harvesting seasons of 1923 and 1924 indicate a lower labour cost for harvesting and hauling grain on the farm in bulk. Thirteen studies made on combines using the bulk method show an average labour cost for harvesting of \$0.58 per acre, the corresponding labour expenditure being 0.92 man-hour. Twenty-three studies of combines using the sack method show an average labour cost of \$1.57 per acre, the corresponding labour expenditure being 2.24 man-hours. The saving at the harvester, made by using the bulk method, was \$0.99 per acre or a saving of 1.32 man-hours per acre. The cost of labour for operating combines includes the wages and board of the crew. The crew on the large-sized bulk-handling combines consists of a tractor driver, header-operator, and separator tender. The crew for sack handling requires one to three additional men to jig (shake) and sew the sacks. The cost of sacks on these farms during the period of the investigation was approximately 14 cents each, and twine for sewing sacks cost about 0.5 cents per sack. The cost of handling empty sacks and twine from the railroad to the farm and threshing machine, although not included in the preceding analysis, is an item of cost which should be mentioned as it amounts to about 3 cents per acre for 15-sack per acre yields. The custom (contract) rate for hauling bulk grain from combines varied, but was generally found to be approximately 50 cents per ton less than the rate for hauling grain in sacks. In some cases the rates for hauling bulk and sacked grain were the same. The saving per bushel, calculated from the above unit savings by using yield records of the California crop for the years 1923 to 1927 is shown in the table hereunder:—

Year.	Yield per acre.		Estimated saving in cost per acre for—					Saving per bushel.
	Bulk.	Sacks.	Sacks.	Twine.	Hauling.	Harvesting.	Total.	
	bus.	No.	dollars.	dollars.	dollars.	dollars.	dollars.	cents.
1923 ... ..	21.6	9.60	1.34	0.048	0.324	0.99	2.702	12.51
1924 ... ..	15.0	6.67	.93	.033	.225	.99	2.178	14.52
1925 ... ..	19.0	8.44	1.18	.042	.285	.99	2.497	13.14
1926 ... ..	18.4	8.18	1.15	.041	.276	.99	2.457	13.35
1927 ... ..	16.8	7.47	1.05	.037	.252	.99	2.329	13.86
Average ...	18.16	8.07	1.13	.040	.272	.99	2.433	13.48

A sack of wheat is estimated to be 2.25 bushels.

When dealing with the savings after the grain leaves the farm it is stated—“The saving resulting from the bulk method of handling grain is not confined to the farm. Every marketing operation that involves the handling of sacked grain is more expensive than it would be if the grain were handled in bulk. The marketing savings are not quite so apparent to the producer as are the farm savings, yet most of the marketing economies of the bulk system will probably be reflected to him eventually through reactions from competitive buying and co-operative marketing.”

The investigators enumerate that there are ten ways in which savings can be effected from the country receiving point to ship's hold, and these, as well as the farm savings, are itemised in the following table in which all overhead charges (depreciation, redemption, etc.) are included in the rates given—

Item.	Cost per short ton (2,000lbs.) for mar- keting grain.		Saving by bulk method.
	In sack.	In bulk.	
	dollars.	dollars.	dollars.
<i>Operation on farm—</i>			
Labor on harvester ... ..	2.88	1.06	1.82
Hauling (contract rates estimated 50 cents a ton less for bulk grain) ... ..	...	...	.50
Sacks at 14 cents each, twine at 0.5 cents a sack ...	2.175	...	2.175
<i>Operation from country shipping point to ships—</i>			
Bad-order sacks and resacks ... ..	.069	...	.069
Sampling, weighing and grading grain ... ..	.06	.04	.02
Smutting charges for 0.5 to 1 per cent. smut dockage	.75	.45	.30
Freight on sacks ... ..	.023	...	.023
Loading cars at country points ... ..	.35	.15	.20
Unloading cars at terminals ... ..	.60	.40	.20
Rosacking wheat after scouring to remove smut ...	.50	...	.50
Delivering grain to ship ... ..	.25	.10	.15
Weighing and inspection of export grain ... ..	.06	.04	.02
Stowing grain in ship ... ..	.50	.20	.30
Total ... ..	...	...	6.277
<i>Summary of possible saving per ton and per bushel by bulk handling of—</i>			
<i>Smutty wheat:</i>			
Saving per ton ... ..	...	...	6.277
Saving per bushel ... ..	...	...	.188
Saving per bushel after deducting discount of 3 cents per bushel on bulk wheat ... ..	...	...	.158
<i>Smut-free wheat:</i>			
Saving per ton ... ..	...	...	5.477
Saving per bushel ... ..	...	...	.164
Saving per bushel after deducting the discount of 3 cents per bushel on bulk wheat ... ..	...	...	.134

Here then are the conclusions of independent investigators, of men accustomed to deal with the economic side of marketing, who show that under conditions very similar to our own the transportation of wheat from farm to ship's hold in bags is more costly than its transportation in bulk. Australians pride themselves upon their efficient means of production. Evidently the methods of transportation are not equally efficient. In the present serious plight of the wheat industry is it economic to retain these inefficient methods, and how long can this waste represented by the difference between the cost of bulk and bag handling be continued to the advantage of our trade competitors?

The greater part of the f.a.q. wheat in this State is smut free, and, in consequence, from the State's standpoint it is only the savings connected with the handling of this type of wheat which need to be considered. On the Pacific coast these from the standing crop to the ship's hold were found to be 16.4 cents per bushel. Before accepting this sum as applying to this State the various items must be subjected to a critical examination. For instance, the saving of 5.46 cents per bushel in connection with the "labour on harvester" seems greater than could be saved under our conditions. A definite saving that would be effected is that now entailed in connection with the sewing, dumping and ramming of the bags: the contract rates for this range from 1d. (2 cents) to 2d. (4 cents) per bag, say, 3 cents, or 1 cent per bushel. It is, therefore, reasonable to assume that 1 cent would be saved: this involves a deduction of 4.46 cents.

It is not clear whether in this State there would be any appreciable difference in the cost of carting bulk and bagged wheat. In the extracts quoted the authors of the bulletin point out that in some cases the contract carting rate is the same for bulk wheat as for bagged wheat. It is, therefore, advisable to also deduct from the Pacific coast savings—the haulage saving of 50 cents per short ton (1.5 cents per bushel). With 3 bushel sacks at 7½d. each the cost in Western Australia for sacks is 2½d. (5 cents) per bushel, as compared with 6 cents on the Pacific coast; this involves a reduction of another cent. In New South Wales the difference in the rates paid for bagged and bulk wheat respectively ranges from 3d. to 6d. per quarter, or ¾ to 1½ cents per bushel in favour of bagged wheat, hence a further deduction of, say, another 1½ cents must be made.

Some exception may be taken to the charge for "grading" in the item "sampling, weighing and grading" in that, in the conventional sense wheat is not "graded" in Australia. When, however, our wheat is sampled and weighed at sidings or elsewhere, its value is also assessed and it is in this sense that the term "grading" has been used and its cost determined. This assessing or grading can be done more rapidly and more cheaply with bulk wheat than with bagged wheat, and the amount of the saving, viz., 2 cents per ton, is considered reasonable for this State.

In this State there is no general Government inspection of wheat for export. The item indicating this saving would, therefore, not be allowable for this State, and should be deleted. It involves a further deduction of .06 cents per bushel.

When the deductions specified are made the savings likely to be effected in Western Australia are set out hereunder:—

Saving per bushel on Pacific Coast	..	..	16.4 cents.
Less possible deductions for W.A.—			
Labour on harvester	..	..	4.46 cents.
Haulage	..	..	1.50 ..
Sacks	..	..	1.00 ..
Weighing and Inspection	..	..	0.06 ..
Price difference in bulk wheat	..	..	1.50 ..
			8.52 cents.
			7.88 ..

Thus a saving of nearly 8 cents or 4d. per bushel is indicated. Suppose, however, that contingencies, such as storage, etc., at present unforeseen, would absorb about half this amount, and that the savings are possibly only 2d. per bushel, it will be

admitted the introduction of "bulk handling" is well worth while. Even if there are no savings I am in accord with the view of an economist friend of mine who writes—"Bulk handling of wheat would be a positive contribution to reviving prosperity if it can be organised and established at a cost showing a *net* increase in the farmer's share of the price obtained for his wheat, or even if merely substituted, without net loss, local jarrah and Australian galvanised iron for Indian cornsacks."

In bulk handling wheat is essentially "up by power and down by gravity," and, in consequence, manual labour is replaced by mechanical power. It is inconceivable to imagine that the adoption of bulk handling in the place of bag handling, by facilities in keeping with the volume of the crop to be handled, will not result in some reduction in costs. There must be savings. There *are* savings; our millers have proved this.

*Can W.A. or, indeed, can Australia, afford to ignore the possibilities of them when so much depends upon reducing costs to save our main industry?*

## PRODUCERS' MARKETS CO-OPERATIVE, LIMITED.

Quarterly report for period ending 15th August, 1931:—

*Fruit.*—Supplies during the early part of the period were short. Windfall navels were heavily supplied with values very low. Lemons were also low, and other lines continued in demand. Towards the latter part of the period apples improved in value, but the quality for the greater part was poor, being very inferior and small fruit. Prime apples of 2½in. and 2¾in. grade in steady demand, but values for other lines low. Navels also improved, snapped navels selling to a firmer demand. Geraldton tomatoes also forward, realising satisfactory prices. Passion fruit and cape gooseberries short and in keen demand.

*Vegetables.*—Supplies of vegetables generally were lighter during the quarter; potatoes generally have shown little variation in value. Odd lines of choice samples of sandgrown winter crops have been offered, and these sold well at higher rates. A good demand exists at all times for lines of exceptional quality. Pumpkin supplies continued steady over the period, and values were on a level, except during the last few weeks when they firmed appreciably. A large quantity of inferior quality has been marketed this season, and it is difficult to find a market for this at any price at all. Buyers are favouring the "Queensland Blue" variety, especially those of medium size. "Trumble," of good colour, was also in better demand. Swedes increased in volume, but the demand held and values were firm for most of the time, but have been glutted during the last few weeks with lower values. Cabbage showed little change; supplies being maintained and values remaining steady for first quality. Cauliflowers were not so heavily supplied this year, and values for the most were good. Generally, we experience a glut of cauliflowers during this period, but from various causes this did not happen this year. Peas from the Geraldton district were on the market towards the end of June, but did not reach the high price that has been obtained in previous years. French beans from the same district made better values, but supplies were much lighter than previously. Both lines reach their peak during August, but as there is a big demand for them at current values, we should be able to handle the crop. Metropolitan gardeners cut out of celery in June, and the market was bare for about



a month until the York gardens started marketing. As is usual this line commanded high values, and some splendid quality was offered. Rhubarb firmed in value during the period, and supplies were maintained. The demand increased, and values firmed for all lines except turnips. Lettuce also showed an improvement, and prime lines sold well at all times.

*Eggs.*—During the month of May the supplies were still short of the demand, and as a consequence the price firmed from 1s. 11d. (ruling in the middle of the month) to 2s. 5d., values realised on 29th May. During the early part of June supplies increased, but the demand being keen the values remained firm on late sales. In the middle of the month there was a noticeable increase which sold at reduced rates to a weaker demand. Metropolitan new-laid realised 1s. 3d. to 1s. 6d., country new-laid 1s. 1½d. to 1s. 2½d. The following week the low prices ruling seemed to have an effect on the public consumption, for although the supplies had increased still more than the previous week the demand was keen and greater than the supply, values advancing to 1s. 6d. and 1s. 6½d. for metropolitan new-laid and 1s. 6½d. and 1s. 7d. for new-laid country. For a few days supplies were still short, and sold to a keen demand with values slightly improved. Metropolitan new-laid realising 1s. 6d. and 1s. 9½d. On 1st July, although the demand was good, it could not cope with the large quantities being received from the metropolitan and country districts, and as a result values began to recede slightly; metropolitan new-laid 1s. 5d. to 1s. 7d. and new-laid country 1s. 3d. to 1s. 4½d. The early part of July showed a considerable increase in the supplies which sold to a fair demand, values being easier at 1s. 1½d. and 1s. 2d. for new-laid country. From 15th July onwards supplies increased, with the result that the supply was greater than the demand, and values receded to 9½d. and 11d. for metropolitan new-laid (specials 10½d. to 1s. 1d.), new-laid country 9½d. to 10d. Then prices receded still another penny, so the growers commenced packing for export on 28th July, and this had the effect of steadying the market, prices again advancing from 8d to 9½d. for metropolitan new-laid and 8d. to 8½d. for country new-laid to 11d. to 1s. 0½d. and 11d. to 11½d. respectively. That was the position at the 8th August, 1931.

*Poultry.*—During May the supplies were from fair to medium, with prime quality in demand. Turkeys were short supplied, with good prices ruling for good quality. Cockerels 6s. to 9s. Hens 5s. to 6s. 6d. Turkey gobblers 15s. 6d. to 21s. Turkey hens 10s. to 12s. 6d. During June all lines were heavily supplied with prime lines in demand, which maintained the rates mentioned above. Owing to the inclemency of the weather in July, supplies were shorter with values firmer throughout. Cockerels 8s. to 10s. 6d.; hens 6s. to 8s.; turkey gobblers 17s. 6d. to 20s.; turkey hens 11s. to 13s. Towards the end of the month of July supplies increased, with the firm values maintained.

*Carcase meat.*—During the quarter pork, veal, and beef were short supplied, with good inquiries for prime quality lamb. Hoggets and mutton have been fair to heavy consignments, which sold well to a good demand. Prices ruling:—Pork 5d. to 7d., veal 4½d. to 6d., lamb 4½d. to 6d., mutton 2¼d. to 4d., beef 3½d. to 5½d.

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## MARKET REPORT.

Messrs. H. J. Wignmore & C., Ltd., of Wellington Street, Perth, have supplied us with the following information regarding Chaff offered at auction in the Perth Railway Yards, for the period June to August (inclusive). In all cases the price quoted is for f.a.q. to prime Wheaten Chaff, packed in new bags:—

Quantity.				Maximum.			Minimum.		
Tons.				Per ton.			Per ton.		
				£	s.	d.	£	s.	d.
June, 1931	..	..	805	4	7	6	4	0	0
July, 1931	..	..	790	4	7	6	4	0	0
August, 1931	..	..	995	4	7	6	4	0	0

The period under review has been very discouraging from a grower's standpoint; qualities under f.a.q. to prime have been very difficult to quit at low prices. During the months of June, July, and August there has been very little alteration in the price of f.a.q. to prime Wheaten Chaff. At the time of going to press the market remains steady for this quality at around £4 to £4 7s. 6d. per ton; f.a.q. at from £3 15s. to £4; medium qualities from £3 7s. 6d. to £3 10s. per ton.

*Oaten Chaff.*—During the past three months there has been practically no alteration in the prices ruling at auction. Prime quality has been selling at from £3 15s. to £3 17s. 6d.; f.a.q. at from £3 10s. to £3 12s. 6d.; medium qualities from £3 to £3 5s. per ton.

*Oats.*—Throughout the period under review the market remained steady. The closing quotations are as follow:—

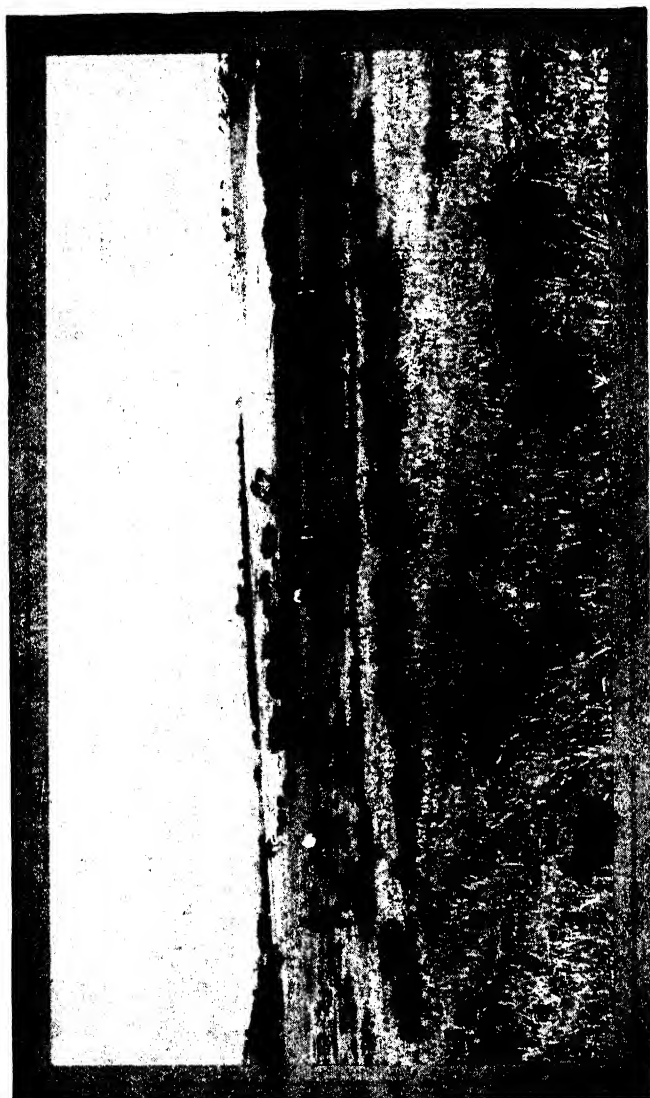
June, July, and August—

Good heavy feeds, 2s. to 2s. 2d. per bushel.

Good feeds, 1s. 9d. to 1s. 10d. per bushel.

Light feeds, 1s. 4d. to 1s. 6d. per bushel.

*Wheat.*—During June f.a.q. was selling at from 2s. 6d. to 2s. 8d.; second grade, from 2s. 3d. to 2s. 5d. per bushel; smutty samples, from 1s. 10d. to 2s. At the beginning of July the market for f.a.q. remained around 2s. 6d. to 2s. 7½d., but towards the end of that month the market eased to 2s. 3d.; second grade, from 2s. to 2s. 2d. per bushel. During August f.a.q. sold at from 2s. 3d. to 2s. 6d.; second grade, from 2s. to 2s. 2d.; smutty and inferior, from 1s. 11d. to 2s. per bushel.



Harvesting at Northam.

## METEOROLOGICAL INFORMATION.

STATIONS.	TEMPERATURE.			RAINFALL.		RAINFALL. Inches.
	Maximum.	Minimum.	For Month.	Aver- age.		
Mean.	Highest.	Mean.	Lowest.	For Month.	Aver- age.	
JUNE, 1931.						
Chapman State Farm	64.3	74.8	43.2	37.3	2.41	4.38
Geraldton	66.2	75.2	49.3	39.6	1.71	4.85
Walebing	60.0	70.5	38.7	31.0	2.34	4.07
Perth	60.8	70.7	44.8	37.2	6.54	7.04
Kalamunda	58.2	67.6	43.5	36.9	7.47	8.30
Bunbury	60.0	70.0	51.5	33.0	3.94	7.29
Bridgetown	59.0	69.8	35.6	25.8	4.86	5.90
Albany	59.2	66.3	44.6	35.0	3.88	5.47
Merredin State Farm	56.4	64.0	37.1	20.7	1.15	1.95
Northam	61.1	69.8	37.1	30.8	1.96	3.32
York	80.0	69.5	38.3	30.0	1.74	3.37
Narrogin State Farm	55.9	65.8	36.9	28.9	2.28	3.73
Katanning	56.0	65.1	38.5	28.3	1.90	2.96
Cape Leeuwin	59.7	66.0	50.6	45.0	5.43	6.90
JULY, 1931.						
	64.2	72.9	49.0	40.1	4.86	8.39
	66.9	75.0	54.3	39.0	4.13	8.90
	59.7	66.2	45.3	32.8	5.37	3.74
	62.4	69.1	50.2	39.4	7.90	6.70
	57.5	63.3	47.3	40.1	11.14	8.45
	62.0	67.0	48.5	35.5	7.10	6.90
	60.1	66.0	43.3	31.0	5.05	5.80
	59.6	68.8	47.9	41.0	9.29	5.55
	58.9	65.5	44.5	30.0	1.97	1.87
	61.2	67.0	46.0	35.6	3.74	3.48
	61.3	66.0	45.2	32.5	3.75	3.42
	57.9	63.6	43.0	32.0	2.74	4.26
	57.6	63.0	44.6	34.0	2.76	3.08
	59.7	64.2	52.2	47.2	7.86	7.28
AUGUST, 1931.						
	65.8	73.3	46.2	38.4	2.73	2.83
	67.8	75.8	50.5	40.6	2.99	2.85
	63.7	71.2	48.3	38.1	6.84	5.71
	59.8	68.0	47.5	35.0	7.91	6.81
	62.2	69.8	41.0	31.0	5.62	5.31
	61.4	69.8	41.0	31.0	6.36	5.06
	61.5	73.0	46.8	40.8	7.56	5.16
	61.6	74.2	41.6	30.1	2.51	1.40
	63.0	70.8	42.5	30.8	3.46	2.55
	62.8	71.0	41.7	31.5	4.03	2.79
	66.7	69.1	41.3	30.9	4.57	3.11
	59.6	69.7	44.5	35.3	3.39	2.44
	...	...	...	...	...	...
	...	...	...	...	...	5.24

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*The Pruning of Fruit Trees*, by J. F. Moody, Fruit Industries Commissioner:

This publication contains numerous illustrations, being reproduction of photographs taken in this State, of pruned and unpruned trees, which make the details set out in the letterpress particularly easy to understand. Price 2s. 6d.

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SEYBERT J. HAYWARD, Director.

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No. 4

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OUR HOME.

To residents of Perth, and to many who live in the country districts, the old building in which the Department of Agriculture is housed is a familiar site. If walls could speak, of what a wonderful progress they could tell, for the history of Western Australia has been discussed and reviewed, prophecies uttered, memories and experiences exchanged, and congratulations and condolences iterated and reiterated. Laws have been made and confirmed, bills debated, science discussed and new announcements made, while policies pregnant with importance to

the country have been framed and perfected within its precincts. Antiquated in appearance, it still keeps in the van of modern practice, and its venerable look belies the energy and enthusiasm within.

It is interesting to trace its history, for it will soon have reached the fine old patriarchal stage of the centenarian. Culled from some early archives supplied by the State Archives Board are the following particulars:—

The specifications for the building of the public offices in Perth, on St. George's Terrace, opposite the officers' quarters and 30 feet back from the South boundary of the street, were adopted and the contract signed on the 17th October, 1836, the accepted contract being priced at £1,833 15s. 6d. A condition was that it should be completed 15 calendar months from the date of contract, but the last payment (for painting) was not made until some two years later, on 16th February, 1839. The contractors were Edward Powell, John Melbourne, William Hyde, jun., James Minchin, George Green, Alfred Carson, and William Holmes, whilst James Stokes and Richard Jones were sureties for the performance of the contract. Designed by Henry W. Reveley, Civil Engineer, the earlier notes for progress payments are made by him, and those later are by H. Trigg, Superintendent of Public Works.—Ed.

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If you are not receiving the *Journal*, which is issued quarterly, and wish to do so, please forward your name and postal address to the Director of Agriculture, Perth.

The current list of recipients will be revised after the December issue this year, and all who desire continuance, or renewal, are requested to notify the Director of Agriculture, otherwise their names will be removed therefrom.

## HORTICULTURAL NOTES.

GEO. W. WICKENS,

Superintendent of Horticulture.

Each year, generally in August, and never later than September, inquiries regarding the fruit crop expected in the coming season start arriving at this office, and from then onwards the number of inquiries increase in volume until the final estimate is made some time in December. As the main anxiety of most of those who require the information is in connection with the quantity available for export, the principal interest centres in the apple crop, this being the one that figures most largely in the overseas trade from Western Australia, and frequently uncomplimentary remarks are made concerning the officers of the Department, who will not publish an estimate before December, but estimates to be of any value must have a reasonable chance of being somewhere near final results, and those who have earned a livelihood by growing fruit know to their discomfiture the number of unpleasant things that can occur between the "spur-burst" stage of the apple buds in September, and the "set" fruit in December.

From our experience this year, one cannot but think that in spite of all the best of growers can, and did, accomplish, in the way of preparing the trees to bear abundantly, their efforts would have been of no avail but for a hefty lump of good luck. Thrips, which have devastated the orchards of our fruit growing friends in the Eastern States, arrived here just a few days too late to perform a similar act of destruction in Western Australia. It was so close that I must confess to a "goose-fleshy" feeling when I think of it, and I have no doubt there are many others in the industry who experience a catch in the breath when they contemplate what might have happened.

However, that hurdle has been safely negotiated, and no other obstacle having arisen up to date to prevent the trees from functioning as satisfactory producers, I will make a forecast that I believe will not be far astray when the actual returns are known in October next after the bulk of the fruit has been sold.

The average apple crop for the past five seasons, 1927 to 1931 inclusive, has amounted, in round figures, to 725,000 bushels per annum, the highest yield in that period being in 1929 with 1,122,000 bushels and the lowest in 1928 with 409,000. In December of last year I estimated the apple crop for 1931 at a minimum of 800,000 bushels, but results proved I was over-sanguine as the crop did not quite reach 750,000, though there is no doubt the long dry summer and failure of a lot of fruits to reach normal size accounted for most of the shortage.

My estimate for 1932 is 760,000 bushels. I consider this a conservative one, but I am influenced by the fact that the crop in the Mount Barker-Albany district is very heavy (the heaviest in my opinion ever produced in that part of the State), and if this summer proves as dry as last the fruit may be small. In addition to this, the crop in the Bunbury-Pemberton section is comprised largely of "Cleopatras," which may develop "cork" to some extent and thus reduce the quantity available for sale. In the Southern district, Mount Barker-Albany, practically all varieties, excepting "Romes," are fruiting heavily; in the South-West, Bunbury-Pemberton, "Cleopatras" and "Yates" are heavy, "Grannys" about half a crop, "Jonathans" light, with a tendency to bunched fruits on terminals, "Dunnns" nearly a failure, mainly on account of last season's over-crop; "Romes" and "Nickajacks" also nearly a failure, but in this instance thrip was the destroying agent.

Pears, from time of blooming to present date, have had a varied experience; in several orchards frost destroyed the "Bartlett" crop, and in all places the ordinary shedding of young fruits of all varieties has been more than usually severe. Still, allowing there will be less "Bartletts" this season, the crop as a whole will be heavier than last, particularly export varieties—"Josephine," "Winter Nelis," "Comice," and "Beurre Bosc." The pear crop over the past five years has, in round figures, averaged annually 89,000 bushels, and my estimate for this season is 90,000.

Early attempts at forecasting the stone fruit crop went woefully astray, because the comparatively light crop of last season made it reasonable to assume a heavy crop would be harvested this season, but severe frosts as late as the 16th October, and cold showery weather in September, upset all prophecies, and the stone fruit crop as a whole will, I think, be lighter even than last year. "Early Newcastle" apricots have fruited heavily, but all late varieties are on the light side. Japanese plums are much lighter than last year, particularly "Satsuma," which, in many orchards, is a failure. English plums are not largely grown in Western Australia, but the crop of these is about equal to last season. Peaches and nectarines also are about the same as last year.

To summarise:—

#### PIP AND STONE FRUITS.

Kind of Fruit.	Production for season 1930-31.			Estimated production for season 1931-32.		
	cases.			cases.		
Apples ... ..	...	...	749,449	...	...	760,000
Pears ... ..	...	...	80,684	...	...	90,000
Peaches ... ..	...	...	50,223	...	...	50,000
Nectarines ... ..	...	...	11,469	...	...	11,000
Apricots ... ..	...	...	43,840	...	...	40,000
Plums ... ..	...	...	57,956	...	...	45,000

The grape crop will be about the same as last season, with the exception of sultanas, which are heavier. Last season the production of fresh grapes amounted to 56,699 cwt. of table grapes; 50,133 cwt. of wine grapes; and 190,883 cwt. of grapes grown for drying purposes, making a total of 297,715 cwt. As stated above, it is estimated that the production in season 1931-32 will nearly correspond with that of 1930-31.

It is yet too early to make any estimate of the citrus crop.

We are, at time of writing, within a fortnight of Christmas, so I shall take this opportunity of wishing all readers of these notes a Merry Christmas, a Happy New Year, and an export season free from complaints about "water core break-down."

## BUFFALO FLY.

*Measures adopted for the prevention of the spread of the Buffalo Fly (Lyperosia Exigua) from the Kimberley District to the South-Western portion of Western Australia.*

By C. R. TOOP, B.V.Sc., Government Veterinary Surgeon, Derby, W.A.

The Buffalo Fly has long been regarded as a pest inimical to the interests of pastoralists engaged in the cattle-raising industry in Northern Australia. Since its introduction into Darwin about the year 1828, where for reasons apparently not well understood it remained more or less localised for a considerable period, it has spread in ever-widening waves until at the present time the pastoral areas of Northern Queensland are threatened by invasion, while in this State almost the whole of the cattle-raising areas of both East and West Kimberley have become involved; the southernmost limit of infestation at present being defined by the 20th parallel of latitude. Extension has been very rapid during recent years, possibly on account of the fly having more fully adapted itself to environment and climatic conditions. Some conception of the rapidity of its spread in North-Western Australia may be gained from the fact that, in November, 1928, an investigation of the position revealed the fly not to be in evidence further south than the 18.30° parallel of latitude, whereas when a further investigation was made in March of the year 1931, the fly was detected almost as far south as the 20th parallel. It is estimated that during this interim the fly had advanced in its forward march a distance approximating one hundred miles.

As the Buffalo Fly, its life history and habits, have been fully investigated and described by others, it is intended only to mention this subject briefly in passing, and then only for the purpose of providing a clearer understanding of the motives which actuated this Department in the initiation of measures calculated to prevent its extension from the Kimberley district to the south-west portion of the State, and, further, that the significance of any such measures might the more fully be recognised.

The Buffalo Fly is essentially a parasite of bovines, though other animals such as donkeys (particularly), mules, and horses may sometimes be attacked. When the life history of the fly is considered it will be seen that the infestation of these latter animals is more or less of an accidental nature.

The fly is a relatively small greyish insect, scarcely more than half the size of the common house fly (*Musca domestica*). When poised, it appears broadly triangular in shape, the apex being formed by the head and thorax which are comparatively small in proportion to the wing span. It is very tenacious of life. When grasped between the thumb and forefinger it is quite resilient to the touch, giving one the impression of handling a small piece of india rubber. When released after considerable pressure, it escapes and is able to fly with activity unimpaired.

The Buffalo Fly is a biting blood-sucking insect adhering closely to its host to which it remains attached both night and day. If disturbed it rises rapidly but just as rapidly descends upon its host.

Under natural conditions its favourite sites of attachment are the following:—Behind the poll and base of horns, the withers, the lumbar region of the back, and low down on the flanks and ribs towards the abdomen. When infestation is gross flies may be observed adhering in clusters to these areas; they having obviously

been selected on account of their comparative inaccessibility to the disturbing influence of the tail of the beast. All other portions of the body are, of course, subjected to attack but upon these flies are never observed in such large numbers!

The Buffalo Fly breeds in bovine manure. The eggs are deposited by the female upon the surface and in the crevices of fresh faeces, and after hatching the usual cycle of larva to pupa to adult fly is undergone. According to Murnane's observations the whole life cycle from egg to adult may occupy a period of only nine days when conditions are favourable to propagation. Multiplication under such conditions may therefore occur very rapidly.

*Seasonal Incidence.*—The Buffalo Fly has a seasonal incidence, its numbers increasing enormously after the onset of the wet season which, in North Australia, usually extends from December to April. By the end of the wet season and for a short period thereafter, flies are usually present in very great numbers. With the onset of cooler weather conditions and drying easterly winds towards the middle or end of May a gradual diminution of numbers occurs until by the end of June a minimum of usually very light infestation is reached. Although a sharp rise and a progressive increase in temperature occurs from August onwards to November, this minimum of infestation persists and no appreciable increase in numbers occurs until wet weather conditions again make their appearance. Both temperature and humidity play an important rôle in the propagation of the Buffalo Fly: the one appearing no less important than the other in this respect.

*Seasonal Variation.*—In addition to a seasonal incidence there is a seasonal variation. In extremely dry seasons an apparently entire disappearance has been observed to occur by the end of June even on coastal areas, whereas in wetter seasons considerable infestation has been noticed to persist on such areas throughout the year. In the West Kimberley district the Buffalo Fly is to be regarded almost essentially as a coastal pest, the humidity factor playing an important part in this connection. Infestation at all periods is invariably lighter on inland areas and the disappearance of the fly therefrom usually synchronises with, or at all events, follows close upon the termination of the rainy season.

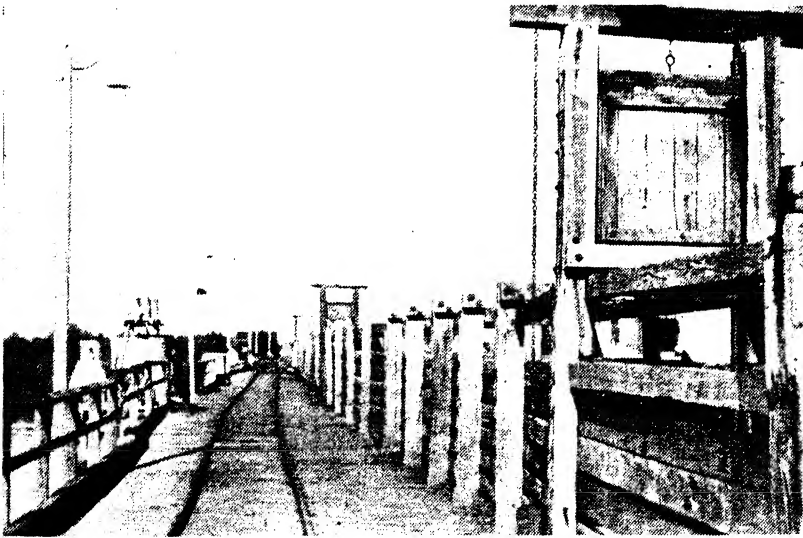
Coastal infestation is itself subject to considerable variation, *e.g.*, in the Broome district where heavy dews occur throughout the year flies are invariably to be observed in quite considerable numbers. In the Derby district, on the other hand, where no such dews are recorded infestation has been noticed to have almost, if not entirely, subsided during the winter months. It is doubtful, however, whether in any season the inhibitory influences of comparative cold and dry atmospheric conditions are at any time capable of bringing about an absolute disappearance.

*Effects of Infestation.*—Cattle hitherto clean have been observed to exhibit intense "fly worry" when suddenly exposed to heavy infestation. This is evinced by restlessness, almost constant tossing of the head and switching of the tail. This condition has not infrequently been observed amongst dairy cows in the township of Derby which have become infested on the arrival of station cattle for shipment at that port. On the other hand, cattle bred on infested country and those which for a period have been accustomed to heavy infestation appear to acquire a very definite tolerance towards the fly. Amongst such cattle there is little evidence of "fly worry" apparent, though they do exhibit some uneasiness when infestation is gross. The fly nevertheless exacts its toll in the quantity of blood that is drawn in feeding. When flies are present in countless thousands as they frequently are, this must be very considerable, and is doubtless accompanied by a loss of condition. What condition is lost by this means it is not possible to estimate. Furthermore,



the irritation caused by the fly and the endeavours of the beast to allay such irritation by rubbing against objects such as trees and ant beds is sometimes responsible for the formation of raw, abraded granulating wounds, chiefly to be noticed beneath the jowl and along the dewlap. These wounds may be up to two inches in diameter and are rather slow in healing. A similar condition is at times noticed at the medial canthus of the eye in unpigmented Hereford cattle. I do not know that colour plays a very important part with regard to infestation—perhaps dark-coloured beasts are more frequently selected by the fly—but it is certain that fine-haired, smooth-coated animals are more frequently the subject of attack than “soft” long-haired beasts. When infestation is heavy, however, neither of these factors are of much importance.

The redeeming feature, if such it may be termed, with regard to Buffalo Fly infestation in North-West Australia is its seasonal incidence. As previously stated, the peak of infestation is reached and maintained during and for a short period after the termination of the rainy season. Then pastures are green and luxuriant, cattle are strong and in good condition and are well able to withstand the attacks of the fly, suffering little apparent detriment. During the dry season which extends from May to December, and particularly towards the latter, and when cattle, especially breeders and young stock, are struggling for an existence under the severe conditions of partial drought which invariably prevail annually in the Kimberleys, infestation sinks to a minimum and the much weakened animals are, fortunately,



The Cattle Race, Derby Jetty, and Spraying Plant.

little troubled by the pest. For this reason the Buffalo Fly is to be regarded as an animal parasite, as of secondary importance to the cattle tick (*Boophilus Australis*). In the latter case the highest degree of infestation is frequently reached when the condition of the animal, and its vitality, are at their lowest ebb.

Having regard to the habits of the fly, *i.e.*, its continuous attachment to its host as well as its apparent tenacity of life, it was early recognised that this pest might easily be transported to Fremantle with cattle shipped from Derby and Broome. By such means a gap of sixteen hundred miles might have been

bridged in the space of a few days of travel, and a pest at present confined to tropical North Australia might have been thus introduced into the dairying areas of the South-Western portion of the State. Attention was drawn to this possibility by Murnane in 1926 and by myself in 1928. Evidence available up to that time had shown that while flies did accompany the cattle on to the ship at the time of loading both at Derby and at Broome, a total disappearance occurred when colder weather conditions were encountered upon rounding the North-West Cape. It was not until the year 1929, however, that the Buffalo Fly was actually observed to reach Fremantle on North-West cattle boats. This occurred amongst a consignment of cattle shipped from Broome in March of that year. During that period of the year warm weather condition would prevail during the whole of the southward voyage.

With the fly at Fremantle, and, so to speak, at the very back door of the dairying industry, the position was regarded as a serious one, calling for immediate action. The need was further emphasised by the result of experiments subsequently carried out by Mr. L. E. Newman, the Entomologist of the Department of Agriculture, who succeeded in breeding out in the laboratory at Perth a local generation of flies from flies captured on a North-West cattle boat:—

On April 27th, 1929, these flies were placed in the insectary and provided with fresh bovine faeces upon which they deposited eggs. On May 27th—one month later—several Buffalo Flies emerged. The maximum temperature on the day of emergence was 63 deg. F., the minimum on the previous night having been 52 deg. F. These survived for six days without food, being exposed in a glass jar to night temperatures. During this period the minimum temperature recorded was 46 deg. F, and the maximum 70 deg. F. The mean minimum temperature for the period was 50 deg. F., and the mean maximum temperature 65 deg. F.

On May 28th a second lot of flies were captured and placed under identical conditions. Eggs were deposited on May 31st. On July 16th—forty-six days later—flies issued. The following temperatures were recorded during this period: Maximum 72.8 deg. F., minimum 33.8 deg. F., mean maximum 61.7 deg. F., mean minimum 47 deg. F. These experiments indicated that even under the mid-winter climatic conditions of Perth the fly was able to pass through its life stages without application of artificial heat.

The assumption that flies transported to Fremantle on North-West cattle might readily establish themselves amongst the dairy herds in the relatively mild environs of Perth and Fremantle, was not, therefore, an unreasonable one. Furthermore, it did not require a very far flight of the imagination to envisage a time when, by a process of gradual adaptation to changed environment, the pest would become firmly established in the less equable climatic conditions of the principal dairying areas of the State.

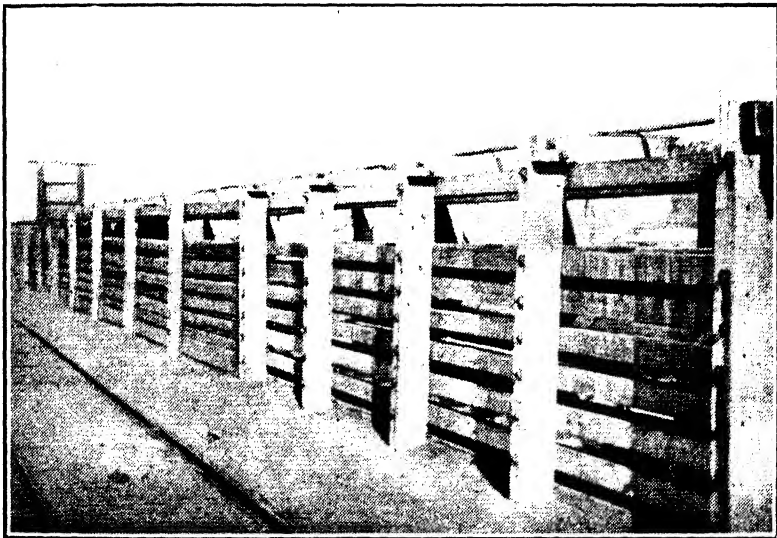
Recognising the seriousness of this menace it remained now to devise a means whereby the risk of such introduction might be obviated.

Spraying of the cattle on board ship with some lethal agent, subsequent to loading, was first mooted, but here there was an important factor to be reckoned with, *viz.*, the disposal of the manure accumulated during the southward voyage. This is a product of considerable value as a fertiliser to market gardeners in the Spearwood district. Considering the life history of the Buffalo Fly, *i.e.*, the fact that it breeds in bovine faeces, it was patent at the outset that in order to render the South-West absolutely safe against its introduction, such manure would of necessity have to be dumped at sea, which would exclude from release and distribution amongst the Spearwood growers a product of considerable value to them

commercially. It was, therefore, considered that the safest method that could be adopted would be the treatment of all cattle prior to embarkation at the northern port of shipment, for the purpose of ensuring that they would be free of infestation before departure from that port.

Two important points now presented themselves for elucidation, *viz.*:—(1) The determination by experiment of a substance which, when applied to infested cattle, would prove both lethal and repellent to the Buffalo Fly. It was further necessary that any such substance would prove non-injurious to the host, and that its cost would be such as would render its use practicable from an economic aspect.

(2) A mechanical means whereby such substance might be applied expeditiously and efficaciously to the cattle. In the latter connection it had to be remembered that cattle were being shipped in consignments, the numbers of which ranged from 320 to 760 head, and that owing to the vagaries of the tides in their influence upon shipping the maximum time available for loading did not exceed six hours.



The Cattle Race, Derby Jetty.

The project of treating the cattle in the loading race by means of a shower spray was carefully considered, its practicability tested out, and plans embodying the requirements of such a spray submitted to the Chief Veterinary Officer. These plans were elaborated by Mr. Golding, Acting Controller of Abattoirs, and a plant as outlined constructed. After carrying out preliminary trials upon cattle at Midland Junction which were accompanied by satisfactory results, the plant was consigned to Derby, installed and successfully operated in July of 1929. Since that date it has always been employed during the loading of cattle. With the passage of time and the acquisition of additional knowledge of the requirements for maximum efficiency, many improvements have been effected, but the plant as it stands at present is the same in principle as the one which was originally constructed.

In the meantime, in collaboration with the Entomological Branch, experiments for the determination of a substance lethal and repellent to the Buffalo Fly and

suitable for spraying purposes were being carried out. Preliminary experiments were performed in the laboratory at Perth, and those substances, which it was considered might prove effective, were consigned to Derby for actual testing against the Buffalo Fly. These experiments have been in progress during the past three seasons. The methods adopted are simple and are as follows:—

(1) The spraying of infested cattle with the substance under test by means of a hand pump fitted with a Bordeaux nozzle and capable of producing a fairly heavy spray.

(2) The spraying with the substance under test of flies imprisoned within gauze containers. For this purpose, flies are released from the catching net into wide-mouthed mason jars from which they are liberated into cylindrical wire gauze receptacles. The spray is applied in atomised form through the meshes of the gauze by means of a small pump.

While results secured by these methods could not be regarded as absolutely conclusive, they, nevertheless, served to provide fairly accurate information as to how these substances would behave when employed in the shower spray in the loading race.

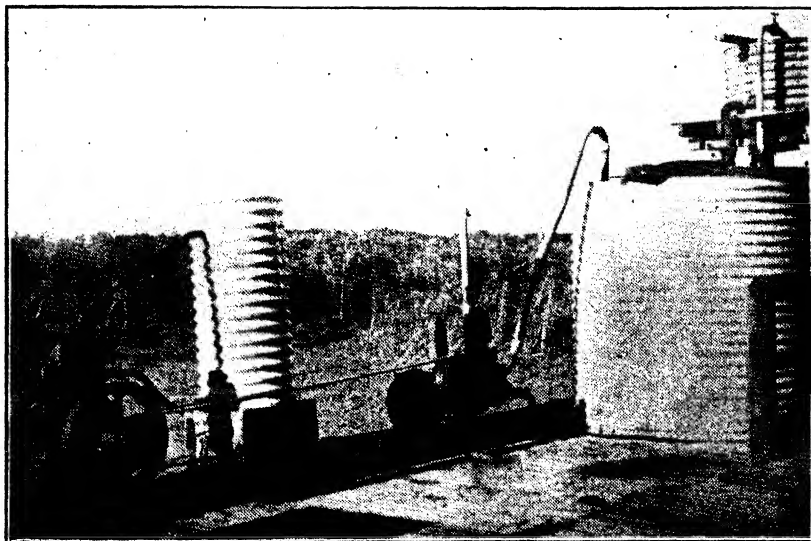
The results secured with the various substances experimented upon are set out hereunder in tabulated form. Though somewhat incompletely presented, this will serve to show the relative efficacy of the various materials submitted to test. The cost per 100 gallons of mixed solution, i.e., the strength in which it is intended for use, which is of cardinal importance from an economic point of view, is included. No computation of cost has been made in the case of those substances which on experiment proved ineffectual; this, in the circumstances, appearing unwarranted.

Substance.	Dilution with Water.	Lethal Action.	Repellant Action.	Effect on Animal.	Approximate Cost inclusive of freight per 100 gallons Mixed Solution.
Phenyle ...	1 in 25 ...	None ...	Transient when animal wet	None ...	Not computed.
Kerosene Emulsion ...	1 in 40 ...	do. ...	do.	do. ...	do.
Flytox ...	Concentrated	Immediate	Immediate	do. ...	£90.
Pling ...	do.	do.	do.	do. ...	£90.
Izal ...	1 in 125 ...	None ...	Transient when animal wet	do. ...	Not computed.
Pyrethrum Powder, 184lb. ...	Water, 125 gallons 1 in 40, 1 in 60	do. ...	None ...	do. ...	do.
Izal, 1 gallon ...		do. ...	do.	do. ...	do.
Vacuum Spray Oil	1 in 40, 1 in 60	Slowly lethal on contact	do.	do. ...	do.
Clensel ...	1 in 25 ...	Rapid disabling effect. Moderately lethal on Contact	Transient when animal wet	do. ...	£2 1s. 9d.
Clensel ...	1 in 15 ...	Immediate disabling effect. Rapidly lethal on Contact	do.	do. ...	£3 7s. 9d.
Bedwell's Blow Oil	Fly 1 in 40, 1 in 50, 1 in 60	Immediate disabling effect. Rapidly lethal on Contact	do.	do. ...	17s. 6d. (1 in 60 dilution).
Carbolicide ...	1 in 20 ...	Immediate disabling effect. Very rapidly lethal on Contact	do.	Slightly irritant to conjunctival Mucosa	10s.
Carbolicide ...	1 in 18 ...	Immediate disabling effect. Very rapidly lethal Contact	do.	do.	20s.
Benzophen ...	1 in 40 ...	Identical with Carbolicide, 1 in 20	...	...	13s.
Benzophen ...	1 in 32 ...	Identical with Carbolicide, 1 in 18	...	...	15s.
Form-o-leen ...	1 in 40 ...	Moderate disabling effect. Lethal on Contact	Transient	Irritant to Mucous Membrane	Not computed.

From the foregoing it will be observed that the proprietary mixtures "fly tox" and "ping" were the most efficacious of the substances tested out. The cost of these materials was prohibitive, and it was at once obvious that they could not be considered for use in the treatment of large numbers of cattle.

Clensel in a dilution of 1 in 25 with water was found to be possessed of a disabling effect which was rapidly produced. This was of a transient nature. After spraying infested cattle disabled flies were noticed crawling on the ground beneath. When kept under observation it was noticed that after a short period the ability to fly was recovered and the flies arose with unaffected vigour. Flies were killed fairly rapidly on being contacted with this material, and after thorough wetting no recoveries occurred. After the inauguration of spraying operations at Derby, Clensel 1 in 25 was employed for a considerable period with satisfactory results, an efficiency estimated as up to 99 per cent. being secured where flies were numerous, and in cases where infestation was not so heavy no flies appeared to survive.

Clensel in the more concentrated dilution of 1 in 15 appeared considerably more effective both as a disabling and lethal agent, but the economic factor of relatively high cost precluded its use in the spraying plant.



Spraying Outfit.

Bedwell's Fly Blow Oil in the respective dilutions of 1 in 40, 1 in 50, and 1 in 60 with water on experiment gave encouraging results. There appeared to be no appreciable difference in action with any of these dilutions. The disabling action, though transient in nature, was immediately produced. It was rapidly lethal to the fly on making thorough contact. Flies so contacted did not recover.

Following upon the results secured by experiment, Bedwell's oil in the strength of 1 in 60 was used in the spraying plant as a substitute for clensel 1 in 25; a high degree of efficiency resulting, it being estimated that even when infestation was gross such efficiency fell considerably less than one per cent. below the maximum possible to secure, *i.e.*, the destruction of all flies. With less heavy infestation 100 per cent. of efficiency appears always to have been secured. More detailed reference to the results of spraying is later made.

It will be seen that from the view point of cost this material was more attractive than clensel, and moreover it was produced within Australia, whereas the latter product was of foreign origin.

Carbolicide in the dilutions 1 in 16 and 1 in 20, produced an immediate but transient disabling action. Both were very rapidly lethal on making contact with the fly, appearing considerably more so in this respect than Bedwell's oil. Of the two the 1 in 16 dilution appeared the more efficacious.

Benzophen in the respective dilutions 1 in 32 and 1 in 40 gave results which were identical with those obtained with carbolicide in the dilutions mentioned above. Benzophen is merely a modification of the substance carbolicide. Following upon our representations to the manufacturers to increase the concentration of the carbolicide supplied for the purpose of reducing high transport charges which apply on the north-west coast, its strength was doubled, the new product for purposes of differentiation being designated Benzophen.

The use of Benzophen 1 in 40 in the spraying plant at Derby has to date been attended by a maximum of efficiency, apparently no flies having survived. As flies have not been present in large numbers since the commencement of its use, it has yet to withstand the test of gross and active infestation. Under such conditions satisfactory results are anticipated with the 1 in 32 dilution.

The cost of this substance is lower and its efficacy apparently higher than that of any other substance previously tested out whose use comes within the ambit of economic practicability.

Benzophen is known to possess a somewhat irritant action to the conjunctival mucus, but this has been responsible for no delay in loading operations, nor has it proved of detriment to the cattle.

It will be seen that none of the substances which came under test were possessed of more than transient repellant properties, and these were only apparent while the animal was wet with solution. Such substances may be sufficiently non-tropic to temporarily mask the attraction odour of the beast, but they are certainly not sufficiently negatively chemo-tropic to prove distasteful to the fly. It would, however, appear that in the treatment of cattle prior to shipment these repellant properties are of secondary importance. It is essential that no flies shall accompany the cattle after they have emerged from the spray, and to meet this requirement it is very necessary that the material employed shall possess markedly lethal properties. It does not appear that a repellent *per se* would prevent flies from following the cattle on to the ship. Though the possession of well marked and lasting repellent properties would doubtless enhance the efficacy of a substance, it is its lethal qualities that are the all-important ones.

In the problem of spraying solutions, it is recognised that there is still much scope for further research work. It would appear that the objective to be sought is the production of a substance of which the vapour or finely atomised spray will itself prove rapidly lethal to the fly.

*The Spraying Plant described.*—The shipping of cattle at Derby involves their passage through a long race extending from the stock yards at the one end, over the jetty to the ship's side at the other. The dimensions of this race are shown in the accompanying plans. It has a total length of approximately 990 feet. For spraying a section 120 feet in length is used within which cattle may be confined by drop gates Nos. 1 and 2. The distance from gate No. 1 to the ship's side measures approximately 270ft. and from gate No. 2 back to the stock yards 600ft. The spray itself consists of three lines of 1½in. galvanised piping—one overhead

and two lateral—running the whole length of the section of 120ft. apportioned for spraying purposes. These pipes are fitted with jets spaced at three-foot intervals, the lateral pipes being set at 20ins. above floor level, and their jets directed upwards at an angle of 45deg. Solution is forced to the pipes by means of a Bulldozer pump driven by a 4½ h.p. Lister engine. The jets are capable of throwing a dense heavy spray which consumes on an average 2½ gallons of solution per beast treated. Solution is drawn from a storage tank of 1,000 gallons capacity. In addition there is a 100 gallon overhead auxiliary tank in which solution may be mixed and conveyed to the large tank by means of a pipe as its supplies become depleted. On account of the difficulty of construction no provision is made for the catchment and re-use of surplus solution which escapes through the decking of the jetty into the sea below. Canvas screens, which may be adjusted in accordance with the direction of the wind, are fitted. Cattle are passed through the spray in lots ranging from 15 to 20 head, according to their size. The rate at which a consignment may be treated is entirely dependent upon the rate at which the ship is able to receive the cattle. Many delays occur. In order that exposure to the spray may be complete and wetting as thorough as possible, the pump is operated while the beasts enter the spray, for a short period while they are standing confined within the block gates, and during their exit. Lot after lot is so treated as required by the ship.

*Results of Spraying.*—After the treatment of cattle prior to loading, it has always been the practice to carry out a subsequent inspection on board ship. Observations so made have indicated that in those cases where flies have been fairly numerous, moderate or small in numbers, none have escaped the spray, but in those cases where infestation has been gross or heavy, a few flies have always succeeded in reaching the boat with the cattle. One has estimated in all such cases that the numbers which have so escaped the spray would represent a small fraction only of one per cent. of those which were originally present. A further inspection by the departmental officer is in addition made immediately on the berthing of the vessel at Fremantle, and it is worthy of note that since the inception of spraying operations such inspection has always revealed the cattle to be quite free of infestation. However, to meet the contingency of infestation having persisted or of breakdown of the plant at Derby, a spray by means of which cattle may be treated on board ship before disembarkation has been installed at Robbs jetty. Moreover, an advantage accrues from the fact that when vessels can be certified clean prior to departure from the northern port of shipment, the release of accumulated manure to Spearwood growers may be permitted.

In addition to the shower spray at Derby, a hand spray has been erected at Broome, from which port comparatively few cattle are shipped annually. Its use appears to be giving equally satisfactory results.

The difficulties of combating Buffalo Fly infestation cannot be overstated when it is remembered that one is dealing with a winged, actively mobile pest. As pointed out, the substances that have so far been used for this purpose rely for their efficacy upon: (1) A transient disabling action which, though rapidly produced, rapidly passes off; (2) A lethal action which is not manifested until the substance actually comes into contact with the fly, thoroughly wetting it. When station cattle are being treated, the crowding in the race which unavoidably occurs renders thorough wetting more difficult to achieve. It would appear that the odd flies that reach the boat on occasions of heavy infestation are those which, having been disabled *in situ*, though not thoroughly contacted with the solution, have subsequently recovered. It is considered that with the use of the more toxic product Benzophen 1 in 32, the difficulty will to a large extent disappear. One assumes

that a second spraying would destroy the few remaining flies. Though conditions of shipping preclude this procedure, it may, nevertheless, as stated, be accomplished at Robbs jetty should the necessity arise.

The task of contacting all flies with the plants at Derby and Broome is in a large measure assisted by a fortuitous circumstance, viz., the conditions under which loading is carried out. On account of hot weather conditions, loading operations are always performed at night. The constant milling of the cattle whilst being worked in the yards and the dust so created, causes the flies to forsake the lower portions of the body, and attracted by the overhead lights, to alight on its dorsal portions, chiefly the back and withers. In this position they are much more easily reached.

Another factor calculated to impair efficiency is the mobility of the fly, and the fact that it appears to be a fairly strong flier. During the months of April and May, when flies have been active, and infestation gross, considerable numbers have been observed in the houses in the township area of Derby, some two miles distant from the stockyards. Having been disturbed during the handling of the cattle, they have reached this area either of their own volition or as the result of having been borne upon the prevailing wind. Fortunately this phenomenon is rarely observed, and though the possibility of such occurring is fully recognised, it does not appear to have played an important part in the reinfestation of treated cattle while awaiting entry to the ship. This factor, however, is obviously one that is beyond the limits of control.

It appears, therefore, that the method of treatment adopted at north-west ports is peculiarly adapted for the purpose for which it is being used, i.e., the treatment of cattle prior to shipment, entrainment, or any other means of transport which will immediately remove them beyond the reach of reinfestation.

It does not appear that this treatment could be recommended in the case of cattle intended for overlanding from infested to clean areas. Such cattle would subsequently be subjected to reinfestation by flies disturbed during their handling and treatment, and to a lesser extent by flies bred in the manure in the vicinity of the stockyards.

Particularly when it is recognised that there is no known substance possessing lasting repellent properties, any method of treatment must obviously embody the immediate removal of treated animals beyond the limits of reinfestation.

#### *Summary.*

1. The Kimberley Division of Western Australia is affected by Buffalo Fly infestation; the South-Western Division is free of such infestation. Transport of cattle by sea from north to south involves a definite risk of the spread of the fly to the clean South-West portion of the State.

2. It has been established that the Buffalo Fly is able to pass through all of its life stages even under the mid-winter climatic conditions of Perth.

3. Infested cattle may be treated by means of a shower spray in which a lethal agent is employed, prior to embarkation at the northern port of shipment.

4. When infestation is gross, the efficiency of such treatment appears to exceed 99 per cent. With lesser infestation, no flies appear to survive treatment.

5. Such treatment is practicable from an economic aspect.

6. Further experimental work is recommended with a view to increasing the efficacy of spraying solutions.

7. Treatment can only be recommended in those cases in which some means exist whereby treated cattle may immediately be removed beyond the reach of reinfestation.



## POTATO DISEASES IN WESTERN AUSTRALIA.

### THE RHIZOCTONIA DISEASE AND COMMON SCAB.

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### INTRODUCTION.

According to the figures given by the Government Statistician in Part V. of the "Statistical Register of Western Australia," for the Seasons 1920-21 to 1929-30, both inclusive, the average annual area under potatoes during this period was 4,689 acres, with an average yield over the whole period of 3.8 tons per acre.

The figures for the various seasons mentioned were as follows:—

Season.*	Acreage.	Yield.	Yield per acre in tons.
1920-21 ...	4,245	13,368	3.1
1921-22 ...	3,612	13,605	3.8
1922-23 ...	3,621	15,198	4.2
1923-24 ...	4,761	17,830	3.7
1924-25 ...	5,122	19,891	3.9
1925-26 ...	4,262	16,052	3.8
1926-27 ...	5,144	17,755	3.5
1927-28 ...	5,280	16,746	3.2
1928-29 ...	4,819	18,774	3.9
1929-30 ...	6,024	27,546	4.6
Average, 1920-30	4,689	17,676	3.8

Such a low average yield per acre is undoubtedly due in a large measure to the prevalence of diseases of various kinds. This is borne out by the fact that the average yield obtained by growers using Government-certified seed, since the inception of the Seed Certification Scheme, five years ago, as computed by Mr. E. T. Morgan, Officer-in-Charge of the Potato Branch, has been from 8-10 tons per acre. Where the manurial and cultural treatments have been identical, certified seed has constantly given a yield of from four to five tons per acre over that of non-certified seed grown alongside. This is very largely due to the reduction of virus diseases in the process of producing the certified seed. In fact, the elimination of disease, in so far as may be humanly possible, constitutes the chief *raison d'être*, or justification, for the existence of the Seed Certification Scheme. Yields as high as approximately 23 tons per acre have been obtained by the use of certified seed.

Up to date the highest yield recorded for Western Australia has been obtained by the use of such seed, and was at the rate of 23 tons 7 cwt. per acre, the same grower having taken 40 tons off two acres. Such yields are, of course, only obtained by a combination of the following factors:—

1. Suitable soils and localities.
2. Seed selection—preferably the use of Government-certified seed.

\* For the purpose of the statistical records, the season is taken as commencing on the 1st March in each year.

3. Seed disinfection before planting.
4. Racking of the tubers to secure sprouted seed.
5. Elimination of all tubers on the racks showing "thready eye" or other undesirable characteristics.
6. Careful preparation of the soil, including adequate drainage.
7. Adequate manuring.
8. Careful cultivation during the growth of the crop.
9. Intelligent use, when required, of spray mixtures or dusts to control such diseases as Early and Irish Blights, and also insect pests.

### DISEASES.

The following diseases have been recorded on potatoes in this State:—

#### Name of Disease and Cause.

Rhizoctonia Scab, Stem Canker or Rosette—*Rhizoctonia solani*.

Common Scab—*Actinomyces scabies*.

Eelworm Scab—*Heterodera radicum*.

Eelworm Scab—*Heterodera radicum*.

Silver Scurf—*Spondylocidium atrovirens*.

Early Blight—*Macrosporium solani*.

Storage Disease—*Macrosporium solani*.

Bacterial Wilt, Brown Rot or Sore Eyes—*Bacillus solanacearum*.

Irish Blight—*Phytophthora infestans*.

Blackleg—*Bacillus atrosepticus*.

Mosaic—Ultramicroscopic parasite (virus).

Leaf-roll—Ultramicroscopic parasite (virus).

Streak—Ultramicroscopic parasite (virus).

Hollow Heart—Excessive rate of growth in coarse varieties.

Hot Formalin injury—Tubers left covered too long after treatment with hot formalin.

Fleck (Internal Brown Spot or Sprain)—A complex group. One form is caused by hot, drying winds during the ripening-off period of summer-dug potatoes on sandy soils.

### 1.—RHIZOCTONIA SCAB, ROSETTE OR STEM CANKER.

(Caused by *Corticium vagum* B. & C.=*Rhizoctonia solani*, Kuhn.)

#### Susceptible Plants.

This disease is the most widespread of all potato diseases, and it has been recorded from every part of the world where potatoes are grown commercially. The fungus responsible for the trouble is known scientifically by either of the two names given above. The first name is applied to the fungus when in the spore-forming condition, while the second name is that which is applied to the fungus in its much more common sterile condition.

Many other plants beside the potato are attacked, and amongst those which have been recorded in various parts of the world are beets, carrots, lucerne, red-clover, onion, raspberry, turnips, peas, celery, lettuce, beans, cabbage, carnations, parsnip, rhubarb, violets, egg-plants, radish, sweet potato, strawberry, tomato, and spinach. The fungus is a frequent cause of "damping-off" of seedlings. In America, losses ranging from 5 to 50 per cent. of the potato crop in various districts have been recorded on account of the ravages of this parasite. In Western Australia the disease has only become of serious moment during the past few years, as Herbert in 1920 stated that "*Rhizoctonia* is not common here though frequently found in imported potatoes."

*Symptoms shown by affected plants.*

The disease is best known to the grower and to the general public as hard, sooty-black scabs or fungus-bodies on the surface of the tubers, which will not readily rub or wash off. These black bodies, which really represent resting stages in the life history of the fungus, are frequently very numerous and give the affected tubers the appearance of having been more or less thickly sprinkled with irregular drops of molten pitch or tar. (See Figs. 1 and 2.)



Fig. 1.—Potato tubers showing black *sclerotia* (or resting-bodies) of the fungus *Rhizoctonia solani*.

(Photo. by author from preserved specimens.)

They are known as *sclerotia*, and may vary in size from mere pin-points up to huge structures occasionally covering an area of several square inches. As they do not penetrate the skin, they are in consequence removed when the tubers are peeled.

Nevertheless, their presence is detrimental to the market value of the potatoes, as they considerably detract from their appearance. Their presence on seed tubers is, however, of far greater consequence than in the case of tubers sold merely to be

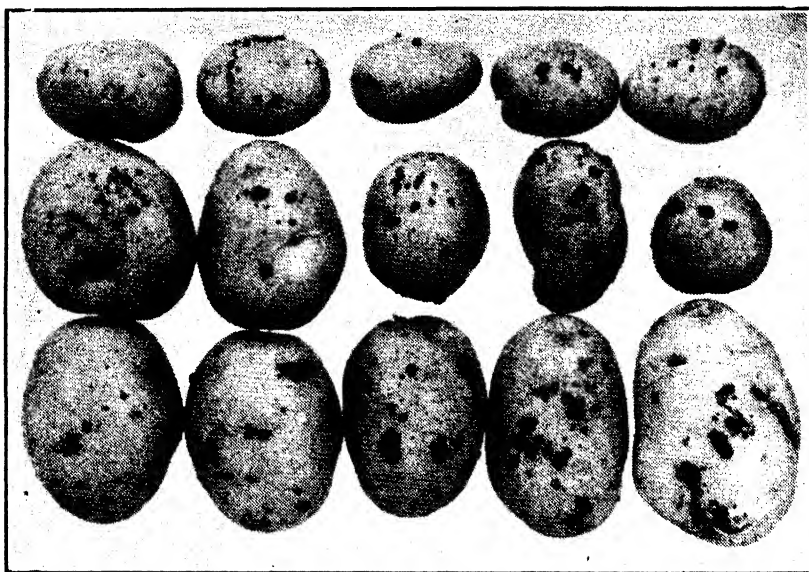


Fig 2.—“Delaware” potato tubers showing the typical black or brownish resting-bodies (*sclerotia*) of the fungus *Rhizoctonia solani*.

(Photo. by author.)

consumed. When infected setts are planted the *sclerotia* give rise to colourless or brown fungus threads which work their way along the surface of the potatoes, or through the soil, to the young potato shoots and may proceed to attack them at the tips or else lower down, causing a dark brown or black canker (see Fig. 3). The result is that many of the shoots are killed, and a greatly reduced stand may result. *This constitutes one of the most serious aspects of the Rhizoctonia disease.* The affected shoots often throw out new buds lower down, and these may in turn be attacked. This attacking and renewed growth may be repeated a number of times, until the sprout is finally killed altogether, resulting in a missing hill, or the plant may break feebly through the soil a long time after the healthy hills are up. Reduction in stand is most commonly caused by *Rhizoctonia* in this State in potatoes planted in spring or autumn.

If the base of the stem is not infected until the plant has gained considerable size, it may not be killed, but a shortening of the internodes at the growing point may result (as a consequence of the reduced water supply, etc., reaching the

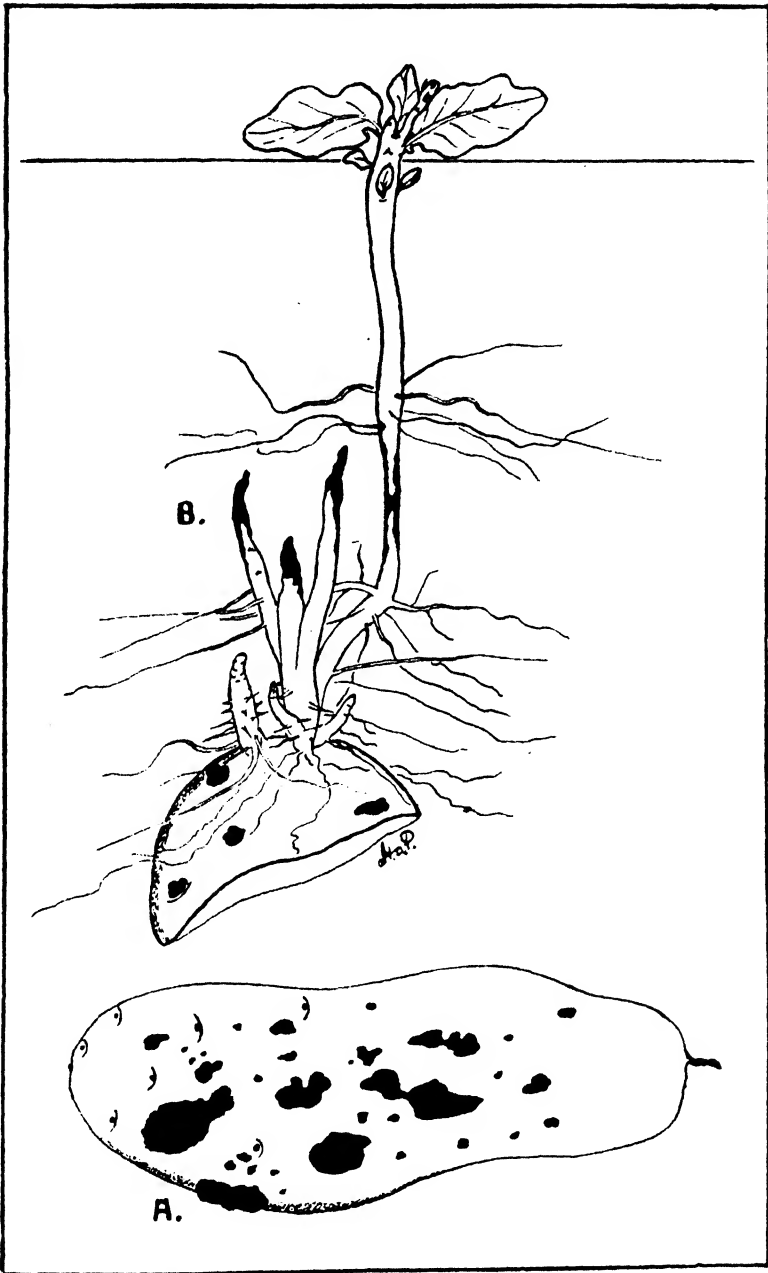


Fig. 3.—A.—Potato tuber showing many resting-bodies or *sclerotia* of the fungus *Rhizoctonia solani*.

B.—Germinating sett showing the killing-back of the sprouts and stem-cankering which may occur when *Rhizoctonia*-infested tubers are planted. The resultant missing hills or weakling plants constitute one of the most serious aspects of the *Rhizoctonia* disease.

growing tissues), and a massed or rosette effect may be given to the topmost leaves. These leaves may turn yellow or remain the normal green. Where the canker on the stem does not penetrate deeply enough to shut off or reduce the supply of water and dissolved minerals, but does penetrate deeply enough to interfere with the movement of sugars down to the tubers, there may result an accumulation of synthesised food materials in the top of the plant. In an endeavour to propagate itself, or at least find an outlet for this accumulation of food materials, tubers known as "aerial tubers" may be formed in the leaf axils on the above ground parts of the stems (See Fig. 4).

Potato plants, which are only attacked by *Rhizoctonia* when fairly well grown, can usually be picked out from a distance by their stiffly erect attitude, the yellowish colour of the foliage, and by the rolling up of the leaflets so that their somewhat lighter-coloured lower sides are rendered very conspicuous. Examination of the stems of such plants below ground level will reveal one or more characteristic brownish cankers more or less encircling the stems.

The cankering phase of the disease is of most serious moment in this State during the spring (in potatoes planted in June-July), and during the autumn (in potatoes maturing in April-May). Deposition of *sclerotia* on the surface of the tubers is apparently stimulated by falling temperatures, and the most thickly infested are those dug from the drained, peaty, swamps in autumn.

In very wet weather the fungus may form a white cob-webby sheath of threads about the base of the stem. This is the reproductive stage of the fungus known as *Corticium vagum*. So far this stage has not been recorded in Western Australia.

It is said that *Rhizoctonia* may cause pitting of the surface of the tubers, but this seems to be very doubtful.

#### *General Considerations.*

*Rhizoctonia* attack is greatly influenced by the environmental conditions. In this connection temperature often appears to be the most important factor. The temperatures at which the fungus does most injury are between 59-70deg. F. Other things being propitious, the fungus is most destructive at a soil temperature of 64deg. F. It thrives best in acid soils, and on this account liming gives good results in its control. Unfortunately the position is complicated by the fact that Common Scab (*Actinomyces scabies*) is favoured by liming, and so in avoiding *Rhizoctonia* in this way, one encourages *Actinomyces*. In spite of the fact that acidity favours *Rhizoctonia*, heavy dressings of organic matter such as green manures considerably reduce the occurrence of the disease. Fortunately the same is true of *Actinomyces*, except that fresh farm-yard manure stimulates the Common Scab organism. In both cases the provision of abundant dead organic matter seems to divert the unwanted attentions of the parasites into other more desirable channels.

#### *Control.*

As *Rhizoctonia* is at present so very widespread, and as it may be present on the tubers as a fine, branched, mass of threads which can only be detected by use of the microscope, all seed-tubers should be treated as if *Rhizoctonia* were definitely known to be present, and irrespective of whether or not they are certified.

The following measures are recommended for its control:—

1. Whenever possible, practice rotation of crops. This is one of the most effective means of controlling any plant disease. Cereal crops such as wheat, bar-

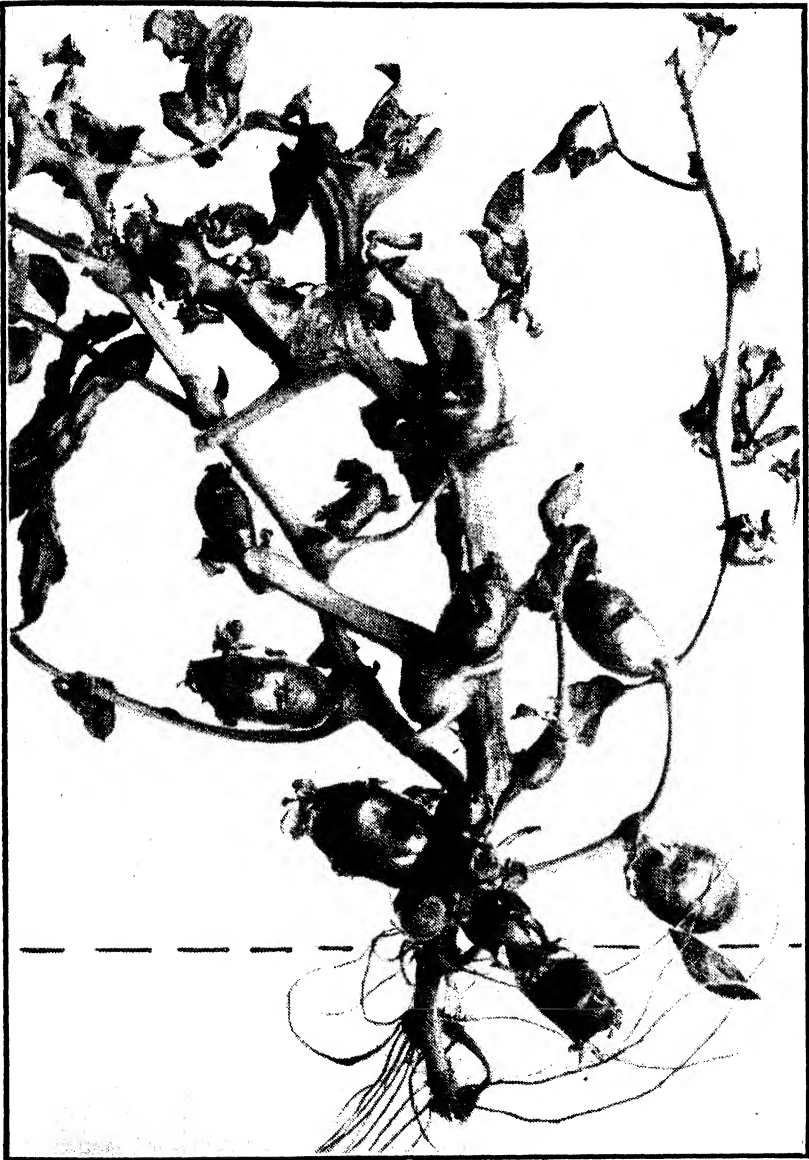


Fig. 4.—“Delaware” potato plant showing “aerial tubers” in the axils of the leaves on the above-ground portions of the stem. These “aerial tubers” are a result of serious mechanical interference with the passage of “manufactured” food materials from the leaves to the underground portions of the plant. While frequently an indication of attack by *Rhizoctonia* they are by no means always so. Continued serewing about of the top of the plant by wind or attack of the stem by insect pests, etc., may have the same effect. The example illustrated was caused by slugs feeding on the stem about ground level, which is indicated on the photograph by the broken line.

(Photo. by author.)

ley, oats, rye, maize and sorghum are not susceptible to *Rhizoctonia* attack. Susceptible crops (*see* commencement of article) should not be grown more frequently than is absolutely unavoidable in the same piece of ground.

2. Use only selected, *Rhizoctonia*-free, seed tubers, whenever possible.

3. Avoid planting potatoes, if possible, during the spring or autumn, especially on infected ground, or if the tubers have not been disinfected. In other words, if potatoes are to be planted at these times, the maximum care and attention in the direction of seed-disinfection and selection of "clean" land, etc., is required. Potatoes planted in spring or autumn suffer most from the "reduction-in-stand" phase of the *Rhizoctonia* disease.

4. Harvest as soon as mature, in autumn-dug crops, in order to prevent rapid increase in the number of *sclerotia* on the surface of the tubers.

5. Plough in as much green manure as possible before potato crops.

6. Irrespective of their source of origin, and whether certified or not, disinfect all seed tubers before planting, in one of the following ways:—

#### A. Cold Formalin Dip.

Soak the tubers, unsprouted and uncut, for  $1\frac{1}{2}$  to 2 hours in a solution of formalin made up at the rate of 1 pint commercial formalin to 30 gallons of water. If the tubers are washed, or dipped in water in the bags, and are kept moist for a day or two before treatment, the effectiveness of the disinfectant is increased and the soaking period in the formalin solution may be reduced to half an hour. The solution keeps its strength, but more solution should be added, as required, to keep up the volume to the original level. Tubers may be dipped in formalin solution in any sort of handy container, irrespective of the material of which it is composed. Formalin does not corrode metals, as does corrosive sublimate. At the end of the dipping period the tubers should be spread out thinly in a cool shady place to dry. The cold formalin is not so effective as the others detailed below.

#### B. Hot Formalin Dip.

Soak the tubers, unsprouted and uncut, for three to four minutes, but no longer, in a solution of formalin, kept at a temperature of from 121deg. to 123deg. F., and made up at the rate of one pint commercial formalin to 15 gallons of water. After treatment the tubers should be immediately spread out thinly in a cool shady place to dry. *If this is not done, considerable pitting of the surface of the tubers may result.* The hot formalin solution may be used in metal containers without any danger of corrosion taking place. A supply of the solution, both hot and cold, should be at hand in order to more readily keep the correct temperature in the dipping tank. A carefully regulated fire may be used beneath the tank to keep the temperature around 122 deg. F. The hot formalin dip is more effective than the cold in controlling any "seed"-borne potato disease.

#### C. Cold Corrosive Sublimate.

This is more effective than the formalin treatments for either *Rhizoctonia* or Common Scab.

Soak the tubers, unsprouted and uncut, for  $1\frac{1}{2}$  to 2 hours in wooden, earthenware, or cement containers (not metals) in a solution of corrosive sublimate made up at the rate of 4 ounces to every 25 gallons of water (*i.e.*, in a "1 in 1,000" solution). *See formula "f," Table 1.* The solution weakens with use, especially if much dirt is present on the surface of the tubers, or if the tubers are dipped in the



bags, so that one ounce of dissolved sublimate (*i.e.*, 1 pint stock solution as per Table 1) should be added to each 25 gallons, after each lot has been treated. Any water necessary to bring the volume up to the original level should also be added each time. *An entirely fresh solution should be prepared after treating four lots.* Each 25 gallons of solution treats about 5 bushels of tubers.

Dip the tubers in wooden crates, not bags, or else immerse directly into the barrel or vat, if provision has been made to drain the solution into another container after the treatment. The effectiveness of the treatment is increased by dipping the tubers in water, or by washing them, and keeping them moist for a day or two before treatment. If this is done the soaking period in the corrosive sublimate may be reduced to half an hour. Also, if the tubers are washed to remove dirt before dipping, and are not immersed in the bags, the solution may be used *six to eight times* before discarding, provided it is strengthened each time as described above. The temperature of the solution during treatment should be not less than 45deg. F. nor more than 70deg. F. If the temperature of the water is more than 70deg. F., the time of treatment must be reduced.

The tubers must be dried thoroughly after treatment by being thinly spread out on racks, etc., or the action of the poison will continue, and damage to the seed may result.

#### D.—*Hot Corrosive Sublimate*—

This is the most recent and apparently also the most successful method of treatment of tubers as a preventative against *Rhizoctonia* and other "seed"-borne potato diseases. The treatment necessitates a wooden tank being used. The strength of the solution is four (4) ounces of sublimate to twelve and one-half gallons of water, but the solution is heated to 110-113deg. F. by injecting steam through a rubber hose from a small boiler or heating plant. The potatoes are dipped for *five minutes* in wooden crates, and are then spread out thinly to drain and dry. The tank used must have a water capacity considerably in excess of the volume of the tubers to be treated at any one time, so that the temperature can more easily be kept uniform. All metal parts of the crates, etc., must be coated with asphalt-paint, tar or pitch to prevent corrosion.

It is not anticipated that many growers will be in a position to adopt this treatment at present, but the method is indicated so that progressive large-scale farmers may take advantage of this information if they so desire, and consider that the saving in time, etc., is worth the expense of the treatment. If adopted, the strength of the solution must be kept up from time to time as indicated above in Section C.

### PREPARATION OF CORROSIVE SUBLIMATE SOLUTION FOR DISINFECTION OF POTATO TUBERS, ETC.

#### *Stock Solutions Recommended.*

Corrosive sublimate (mercuric chloride) is the chemical most commonly used for the disinfection of vegetable and flower-garden seeds, potato tubers, etc., the most frequently used formula being that known as "1 in 1,000." This means 1 part by weight of Corrosive Sublimate (Mercuric Chloride) to 1,000 parts by weight of water. In publications originating in the United States of America, the directions for making up this "1 in 1,000" strength, are to dissolve the Corrosive Sublimate at the rate of 1 ounce in 7½ gallons of water. In British countries, however, the gallon measure used is larger than that used in the U.S.A., so that

the correct formula where using the Imperial gallon as a measure of volume is at the rate of corrosive sublimate 1 ounce avoirdupois in every  $6\frac{1}{2}$  Imperial gallons of water (or 4 ounces to every 25 gallons).

Where large quantities of Corrosive Sublimate solution are required, as in the disinfection of potato tubers or gladiolus corms, the most convenient method of preparation is to make up a stock solution at the rate of one pound of finely-powdered sublimate in two gallons of hot water. The poison may be dissolved by carefully pouring the hot water over it in the bottom of a wooden, earthenware, glass or enamelled vessel. After cooling, the solution should be stored in a tightly-stoppered, clearly-labelled, glass or earthenware jar, etc., under lock and key, till required. **Metal containers must never be used for Corrosive Sublimate solutions, as they are corroded by the disinfectant.** The chemical only dissolves very slowly in cold water, so that hot water should be used whenever possible in making up the stock solutions.

TABLE I.

DILUTION TABLE FOR MAKING 1 IN 1,000 CORROSIVE SUBLIMATE SOLUTION, USING A STOCK SOLUTION OF ONE LB. CORROSIVE SUBLIMATE IN TWO GALLONS OF WATER (OR HALF LB. IN ONE GALLON).

Stock Solution. Take amount indicated below.	Amount of dissolved sublimate in quantity of stock solution taken.	Dilute with clean cold water in wooden, glass, cement or earthenware container to final volume indicated below.
(a) $\frac{1}{4}$ pint	$\frac{1}{4}$ ounce	1 gallon $4\frac{1}{2}$ pints
(b) $\frac{1}{2}$ " "	$\frac{1}{2}$ " "	3 gallons 1 pint
(c) $\frac{3}{4}$ " "	$\frac{3}{4}$ " "	4 " $5\frac{1}{2}$ pints
(d) 1 " "	1 " "	6 " 2 " "
(e) 1 quart	2 ounces	12 " 4 " "
(f) $\frac{1}{2}$ gallon	4 " "	25 " "
(g) 1 " "	8 " "	50 " "
(h) 2 gallons	1lb. "	100 " "

In cases where it is anticipated that only very little of the disinfectant will be required, a more convenient stock solution may be prepared by dissolving  $\frac{1}{2}$  ounce of Sublimate in *one quart* of hot water (or *two ounces in one gallon*) by the same method as indicated above. For use this second stock solution is diluted as follows:—

Table II.

DILUTION TABLE FOR MAKING 1 IN 1,000 CORROSIVE SUBLIMATE, USING A STOCK SOLUTION OF ONE HALF OUNCE ( $\frac{1}{2}$  oz.) IN ONE QUART OF WATER (OR TWO OUNCES IN ONE GALLON.)

Stock Solution. Take amount indicated below.	Amount of dissolved sublimate in quantity of stock solution taken.	Dilute with clean cold, water in wooden, glass, cement or earthenware container to final volume indicated below.
(a) $\frac{1}{4}$ pint	1/16th ounce	3 $\frac{1}{2}$ pints
(b) $\frac{1}{2}$ " "	1/8th " "	6 $\frac{1}{2}$ " "
(c) $\frac{3}{4}$ " "	3/16ths " "	1 gallon $1\frac{1}{2}$ pints
(d) 1 " "	$\frac{1}{4}$ " "	1 " $4\frac{1}{2}$ " "
(e) 1 $\frac{1}{4}$ pints	3/8ths " "	2 gallons $2\frac{1}{2}$ " "
(f) 1 quart	$\frac{1}{2}$ " "	3 " 1 " "
(g) $\frac{1}{2}$ gallon	1 " "	6 " 2 " "
(h) 1 " "	2 ounces	12 $\frac{1}{2}$ " "

The strengths of all stock solutions should be written on the labels as soon as the solutions are prepared, and it would be just as well also to include a copy of the appropriate dilution table on the same or a separate label on the container.

**Mercuric Chloride (Corrosive Sublimate) is deadly poisonous to human, animal or plant life. In addition, it is colourless, odourless, and comparatively tasteless, and may easily be mistaken in solution for pure water. It should, therefore, be used with great care and kept out of the reach of children or farm**

stock. When finished with, the solution should be poured into a hole in the ground, and the hole be immediately filled in or covered over. In case of mercuric chloride poisoning give whites and yolks of eggs mixed with milk. In emergency, ordinary flour paste may be used. Then give a mustard emetic to induce vomiting and send immediately for medical assistance.

## 2.—COMMON SCAB.

(Caused by *Actinomyces scabies* (Thax.), Güssow.)

*Plants Susceptible.*—This disease is found not only on the potato, but has also been recorded by various observers on beetroot, turnips, mangels, rutabagas, parsnips, radishes and carrots amongst others. On potato, the disease is fairly common in Western Australia in certain districts, and especially so where the tubers are grown on soil which has been rendered somewhat alkaline by liming, or in any other way, such as by the burning-off of the native vegetation.



Fig 5.—Common Scab of potatoes due to *Actinomyces scabies*, showing both sides of the one tuber badly affected.

(Photo. by author.)

*Symptoms.*—In typical cases this disease can be readily distinguished from eelworm-scab, which is the only other disease present in this State with which it could possibly be confused. The disease is characterised by the presence of roughened and fissured corky areas on the surface, which contrast strongly with the smooth, lighter-coloured, unaffected neighbouring tissue (see Fig. 5). When

isolated the diseased areas are generally approximately cylindrical, and they usually show a small series of more or less concentric corky ridges and corresponding fissures. The margins of the lesions are generally ridged up above the level of the surrounding healthy skin (see Fig. 6). Only a single lesion may occur on a tuber, but more commonly there are several, and occasionally there may be so many that it is difficult to find an area of unaffected skin. The lesions commence as



Fig 6.—“Delaware” potato tuber showing several approximately circular Common Scab lesions which have begun at *lenticels* (breathing pores) and are gradually extending in area.

(Photo. by author.)

small rusty-brown specks at the breathing pores or lenticels. From these positions they gradually work outwards, and in the course of time may coalesce and form areas of very great extent (see Figs. 5 and 7). In bad cases the whole surface of the tuber may be covered with lesions. Secondary organisms frequently then take control and may soon reduce the tuber to a disintegrating rotten mass. On being dug up, potatoes affected with Common Scab frequently show a very delicate whitish film of *Actinomyces* covering the diseased areas. This very quickly dries up and disappears on exposure to air and light.

Common Scab lesions may be elevated above the general surface of the tuber in the form of warts or blisters, having the outward appearance of eelworm-galls, or they may be nearly on a level with the remainder of the potato skin, or again they may be deeply depressed.

*Cause.*—As stated above this disease is due to *Actinomyces scabies*. The organism is peculiar in that the genus to which it belongs consists of bacteria which form long, thread-like, multi-cellular filaments, which strongly suggest the *hyphae* or threads of the higher fungi. These threads very readily break up, however.

into normal, unicellular, rod-like bacteria. These are able to live on the organic matter in the soil as well as on the surface of the potato tubers and the underground parts of certain other plants. (See section of article dealing with susceptible plants.)

*General Considerations.*—*Actinomyces scabies* is greatly stimulated by the addition to the soil of lime, wood ashes, or any material which will tend to render the soil alkaline. It is for this reason that potatoes following cabbages or other crucifers, which have been heavily limed for the control of Clubroot (*Plasmodiophora brassicae*), are often badly affected with Common Scab. Acidity is unfavourable to its development, and therefore the use of acid fertilisers such as superphosphate, sulphate of potash and sulphate of ammonia will tend to reduce



Fig. 7.—Common Scab due to *Actinomyces scabies* on both halves of each of two "Delaware" potatoes grown on a drained peaty swamp rich in lime.

(Photo. by author.)

the disease. As nitrate of soda, if used for a considerable period, tends to render the soil reaction alkaline, it should not be used where Common Scab is likely to be in evidence. It is unfortunate that alkalinity is favourable to Common Scab, because by increasing the soil acidity to reduce attack by *Actinomyces*, the effect is to encourage *Rhizoctonia*. It has been shown, however, that attacks by both *Actinomyces* and *Rhizoctonia* are reduced by increasing the organic matter of the soil. The grower therefore should make every effort to increase the humus content of the soil by the incorporation of green manures, etc., if his soil is at all deficient in organic matter.

Common Scab is most serious where the soil temperatures are high. It has been shown that it does most damage—other things being favourable to it—at a soil temperature of about 68-77deg. F. The range of development of the disease is given by Jones, McKinney and Fellows as from 11 to 30.5deg. C. (51.8 to 86.9 deg. F.) with but slight infections at either extreme. In certain field trials 77 deg. F. was the most favourable temperature for scab development. Low moisture content favours the disease, so that scab is most serious under a combination of soil alkalinity, high soil temperature and low soil moisture.

### Control.

1. If the soil is badly infested with *Actinomyces*, rotate with other non-susceptible crops. Grasses, cereals or clovers could be used in rotations with good results. Do not use root crops in rotations. A susceptible crop should not be used more frequently than every third year on the same piece of ground.

2. Use clean seed whenever possible. "Avoid the use of badly scabbed tubers for seed, as they will always produce more scab than clean seed, even when given a standard seed treatment." (Heald.)

3. No matter what the source of origin, and whether they are certified or not, treat all seed tubers with formalin or corrosive sublimate (mercuric chloride) as recommended for the control of *Rhizoctonia*.

4. Substances tending to cause soil alkalinity such as lime or wood ashes should not be applied to the soil immediately before growing a potato crop. If they must be used, they should be applied to other crops preceding the potato crop by as long a period as possible.

5. Every attempt should be made on soils at all deficient in organic matter to increase the humus content and the acidity of the soil by the ploughing-in of green manure crops.

6. Avoid using nitrate of soda as it tends to increase the soil alkalinity. Use sulphate of ammonia or blood and bone instead as sources of nitrogen.

As indicating the effect of acidity in reducing the amount of Common Scab, it is interesting to note that in certain parts of America where potatoes are very often grown for many years without a change of crop, the harrowing-in of from 300 to 450 pounds of "inoculated" sulphur before the potatoes are planted has given very good control. This treatment has not been tried out in Western Australia, and no recommendation can be made concerning it.

7. Keep up the moisture content of the soil by irrigation, etc., where practicable, on soils inclined to dry out during the summer.

8. Do not feed uncooked scabby tubers or peelings to animals, and avoid dumping scabby tubers or peelings on the compost heap or fields.

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## ERADICATION OF LICE AND TICK IN SHEEP.

A. MCK. CLARK, L.V.Se.,

Chief Veterinary Surgeon.

The necessity for stockowners to keep their sheep free from ticks and lice cannot be emphasised too strongly. Apart from the compulsory dipping aspect, it is a reflection on good management if every effort is not made towards the eradication of tick and lice from flocks. Owing to the knowledge available no difficulty should be experienced in this regard. Dipping is always associated with good animal husbandry in this State, for one cannot obtain a maximum of return for wool if it has suffered the effects of the ravages of parasites. The plea that one is unaware that such parasites exist shows that insufficient care is being exercised in supervision. On the other hand, to be aware of the existence of tick and lice and fail to adopt remedial measures is even more culpable. To travel or expose for sale in a public place sheep which are affected with ticks or lice becomes an indictable offence for which penalties are provided under "The Stock Diseases Act, 1895."

Although the action taken by the Departmental officers during the last few years has had the effect of bringing about a considerable improvement in the flocks, there is room for greater improvement yet, especially amongst those flocks where sheep are never exhibited for sale. Tick and lice in sheep, if allowed to continue, must eventually go from bad to worse, therefore all persons concerned should realise the position and determine on the right lines to stamp out the trouble.

*Remedy.*—In order that a remedy may be effected, it is first necessary to obtain evidence by examination as to the existence or otherwise of lice or tick in your sheep. In order to do this the sheep should be seized and placed in a sitting position between the feet of the operator with the back of the animal resting against the legs. Special attention should then be paid to the unexposed portion of the body between the chest and the forearms—on the belly, beneath the jaw and the under portions of the neck. Afterwards the back and flanks should be examined.

A full description of both the sheep louse and the sheep tick and how to identify is supplied in this article by Mr. L. J. Newman, Economic Entomologist.

*Dips and Dipping.*—The class of dip used depends upon the number of sheep required to be dipped. For general requirements one cannot do better than adopt the type recommended by the Departmental Sheep and Wool Expert (Mr. McCallum), particulars of which have been previously published but which are reproduced in this article. This can be modified so suit requirements peculiar to the owner.

The best time to dip is one month off shears for short wools, and six weeks for long wool varieties. However, in some parts of the State one recognises the difficulty of a second muster, and in those cases dipping off shears is the only alternative. When this is the case every care should be taken to see that the animals are effectively dipped—preferably in a swim dip.

The advantage of dipping with a month's wool on is obvious, as it affords an opportunity for the solution to take hold, and in consequence the efficiency of the operation is enhanced. Care should be taken not to dip sheep when hot after travelling or when thirsty. Thin sheep require more gentle handling than strong

vigorous ones. When dipping off shears it is always advisable to dress shear cuts with a dab of antiseptic dressing, supplied by dip manufacturers, before immersing.

*Kinds of Dip to use.*—There are many makes of dip on the market, but the only kind recommended by this Department is one containing one-tenth per cent. of arsenious oxide. This class of dip has been proved throughout the Commonwealth to be the most efficacious, and, in consequence, the cheapest in the long run.

Lime and sulphur dips should be avoided except in cases of scab. Lime has a detrimental effect, as it causes the fleece to become hard and harsh in texture, stunted in growth, and a bad colour. From a manufacturing standpoint these are most objectionable, causing dyeing faults and ultimately, indifferent fabrics.

Lime renders fibre brittle, stunts growth, destroys elasticity, causes difficulty in scouring, spoils it for taking dyes, and, finally, can only produce low grade fabrics.

Tobacco dips are objectionable, as wool from sheep so dipped is not suitable for making even ordinary fabrics, and, further, has been proved absolutely useless in regard to the destruction of lice and tick.

Carbolic and alkali dips are not recommended, for the reasons set out in connection with tobacco dips.

The only point to remember in connection with the use of the prescribed arsenical dip is to carefully execute the directions issued by the manufacturers given on packet or container.

The dip should be tested from time to time, so as to ascertain the right strength is being maintained.

## THE SHEEP LOUSE.

HUGH MCCALLUM,

Sheep and Wool Inspector.

### ECONOMIC ASPECT.

Owing to the ravages of the external parasites which are infesting our flocks, namely, lice and tick, our wool, and also the carcase, has suffered considerable depreciation. In these times of great demand for wool and sheep at high prices we cannot afford to temporise with these parasites. The sheep farmer must come to a realisation of the fact that unless he makes a determined effort to eradicate or control these pests, they will sooner or later reduce his sheep and wool to such a state that they will prove unprofitable.

Many of our local clips have held their own with the best of Australia. It has always been noted that the highest values obtained for sheep or wool have been from those sheep that had the necessary care and attention. The owners of these



high-priced wools have shown a careful and intelligent interest in their sheep. The stations or farms have been equipped with facilities for dipping, draining yards, etc.

The prevention of this ever-increasing loss is not a matter of difficulty. The initial outlay in providing the dips and other facilities is soon offset by freeing the sheep of the parasites and the consequent heavier fleece and carcase, which means enhanced prices. It is a great and common mistake of many farmers to neglect these provisions on the grounds that they cannot afford the outlay. "A stitch in time saves nine" is a very true saying, and is very applicable when dealing with lice and tick. A pound spent in prevention or treatment means the saving of many pounds later on.

Sheep that are infested with these parasites give birth to weakly lambs. These in turn become infested, and their development is greatly retarded; thus again is the farmer the loser.

Wool freed from tick and lice is bright, clean, and attractive contrasted with that produced by infested sheep, which is of much inferior quality. It is difficult to estimate the actual financial loss which follows neglect, but sufficient is it to state that it runs into many thousands of pounds per annum.

There is another aspect of the case which is a serious one, namely, the infestation of clean sheep by the yarding of infested sheep in public or private saleyards. These yards become infested, and clean flocks which are being offered for sale pick up these lice or ticks. This often means that the buyers unknowingly take infested sheep on to their property, and thus introduce the pest into otherwise clean areas.

Some difficulty may be experienced by farmers in recognising these pests, but it is hoped that a reference to the notes provided in this article by the Entomologist will assist in this respect.

It is the hope of this Department that before many years all farmers will be the possessors of sheep which are a necessary adjunct to successful farming—hence the reason for all concerned being made acquainted with the need for taking all precautions against the introduction of these pests and making themselves acquainted with the methods of prevention and treatment.

*Sheep Parasites and the Dip.*—When sheep are infested it is necessary that a dipping mixture be applied to destroy the parasites. Sheep are often rushed through the bath, with the result that the dip does not reach the skin, and consequently the pests remain more or less unaffected by the treatment. The dip must penetrate to the skin, not only to destroy the existing parasites, but to protect the animal against becoming re-infested. It is imperative that all owners realise the importance of this and discontinue the habit of rushing the sheep through the dip. Regular dipping is essential, and the instructions issued regarding this must be strictly carried out. Each animal put through the dip requires to be soaked for not less than a minute. Sheep should be dipped from four to six weeks after shearing.

To make a complete success of dipping it may be necessary to repeat the operation some 20 to 25 days later. This, as the Entomologist points out, is owing to the failure of the first dip to destroy eggs or pupæ, which are very resistant stages.

*Care before and after Dipping.*—Adverse climatic conditions at the time of dipping can, and do, have a detrimental effect on the result. They are, however, beyond our control, but by using a dip of unvarying and guaranteed constancy and following the instructions, good results will be obtained. The care and condition of sheep before and after dipping are matters which should not be overlooked.

Sheep should not be dipped during extremes of heat or cold, when thirsty, or in a heated state from driving. When ewes and sucking lambs have been dipped the lambs should be kept apart for a time.

In districts where each farmer cannot afford to put in a separate dip, the matter of installing one on the co-operative system should meet with general support. This can be erected at little cost by the interested parties.

For the information of farmers a diagrammatic plan of an effective sheep-dipping tank has been prepared, and is submitted herewith.

The particulars regarding the materials used in the preparation of the dipping fluid will be found in "The Eradication of Lice and Tick in Sheep," by Mr. Murray-Jones, the Chief Veterinary Officer.

#### EXPLANATION OF DIAGRAM.

*Sheep-dip—"Walk in" Entrance.* (See plan.)

*A* and *B* are supply and crush pens, which are fed from the usual sheep yards, with which the former should be connected. The latter should have a battened floor, the battens being made in sections, so that they can be removed after dipping.

*C* race, nine feet in length, 16 inches wide, sufficient to hold four sheep. This race should have a battened floor, to be removed after dipping.

*D* represents the "walk-in" section, and is an incline nine or 10 feet in length (10 feet is better), gradient one in two, ending in a drop of 12 inches above the bottom of the bath. Its width at the point at which it connects with the race is the same as that of the race itself, namely, 16 inches; hence it gradually widens to 24 inches, to connect with the bath at the other end, of which it practically forms a part. The sides of the "walk-in" section are also, in all respects, identical with those of the bath.

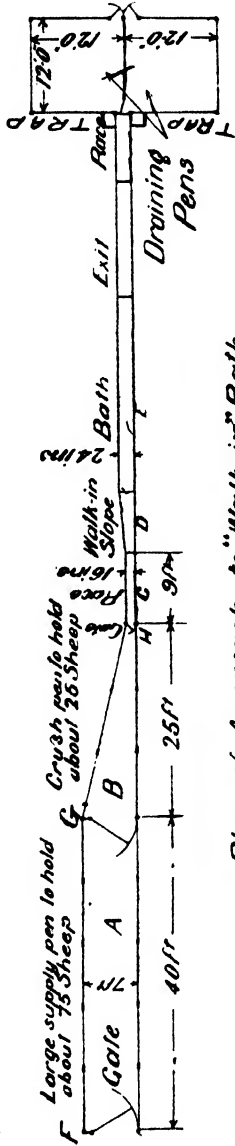
*E*, portion of the swim bath.

*F*, *G*, *H*, represent gates; *F* and *G* are 4 to 4½ feet gates hung on posts 3 feet or 2½ feet from the side fence, so that when open they will close up the angles and form a "lead-in." *H* is a small gate to close the four sheep in the race.

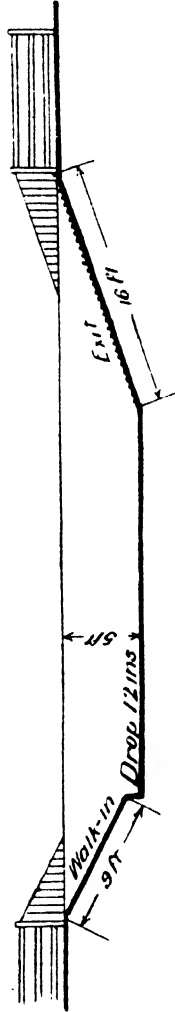
Two draining pens, each 12 by 12, are necessary, and a shed could be erected over same if required.

The size of the above dip can be reduced to meet the requirements of the small stock owner. A dip from 15 feet to 25 feet long is large enough for a small flock.

# *"Walk-in" Entrance Suitable for any Long Swim Bath*



*Plan of Approach to "Walk-in" Bath*



*Section of Bath with "Walk-in" Entrance*

## EXTERNAL PARASITES OF SHEEP.

L. J. NEWMAN, F.E.S., Entomologist.

### SHEEP LICE.

Amongst insects which continually live on domestic animals, propagate on them, and when their numbers increase cause serious injury to their host, none is perhaps worse than the various species of lice.

During the past few years these parasites have shown considerable increase amongst our flocks. In Eastern Australia it is stated that the heavy annual loss to the material wealth resulting from the presence of lice amongst sheep is immense, being greater than that caused by the so-called Sheep Tick (*Melophaga ovinus*).



Sheep infested with Louse and Tick. Note torn and ragged condition of fleece, due to rubbing.

Two species of lice have been determined as present and infesting our local sheep, namely, the Red Headed Sheep Louse (*Trichodectus sphaerocephalus*) (Nitzsch) and the Foot Louse (*Linognathus pedalis*) (Osborn). They belong to the Order *Hemiptera* and to the Sub-Orders *Mallophagidae* and *Anoplura*. In the Sub-Order *Mallophagidae* all members are parasitic, and are known as the biting lice. They do not suck blood by means of a proboscis or beak. Their mouth parts are formed for feeding upon hair, feathers, skin, scales, clots of blood (formed by the infested animal scratching and biting itself) and scabby or other scurvy material found upon the skin or amongst the hair and feathers of their hosts. These lice are most commonly found upon birds. Nearly all farm animals, however, are subject to infestation by some species of this sub-order.

The *Mallophagidae* or biting lice are all small flattened insects, having large prominent head, outstanding eyes, and short, three-jointed antennae or feeders. The legs are short and stout, fitted for holding to and also moving among hair or feathers. The tarsus or foot is terminated with a sharp claw.

The eggs, commonly known as "nits," are fastened to the hair or feathers of the host. The young issue from the eggs in a few days. They resemble their parents, except in size, and reach sexual maturity by a series of moults. Their entire life is passed on the host. They are spread from animal to animal mainly by means of contact. Other mediums of spreading are posts, fence wires, tree trunks,



Tag of wool in mouth of sheep pulled out in its effort to get at the irritation.

and objects against which the lice-infested sheep scratch themselves. Infested wool is often left clinging to these containing either "nits" or living lice. Clean sheep may rub against these objects and thus become infested.

The second group of lice, namely, the *Anoplura*, are the true blood suckers. They differ primarily from the preceding group in that their mouth parts are formed for piercing the skin and sucking up the blood of their host. Further, they are only found infesting mammals (those animals which suckle their young). Their life history is similar to the biting lice and, therefore, needs no further description at this juncture.

All breeds of sheep appear to be subject to the irritating attacks of lice and tick. Animals attacked by lice are extremely annoyed by them, and fall away considerably in condition, partly by the abstraction of juices and partly by the uneasiness which the itching occasions. We not infrequently observe sores on the surface of the skin arising either from the gnawing of the lice or from frequent rubbing of the animal against the fence posts, trees, etc. Sheep often tear off their own wool in their endeavour to get at the itching skin.

The presence of lice can be detected by the tufts projecting over the uniform surface of the fleece. The cumulative increase of lice is very rapid, especially upon animals which have become poor in condition through lack of proper nutritive



Infested sheep, showing typical tufts of wool projecting over the uniform surface of fleece.

foods, or due to some disease. The exceedingly prolific increase has led to the vulgar statement that a louse might be a grandfather in 24 hours. This is, of course, not literally true, but simply indicates that when animals which have become infested and probably living under dirty conditions are not attended to, they soon become poor in condition and consequently heavily infested with lice.

Another important fact, other than the loss of weight and ragged texture of the wool, is the depreciation of the fleece by staining, which arises from the excreta of the lice.

### THE RED-HEADED SHEEP LOUSE.

(*Trichodectes Sphaerocephalus*, Nitzsch.)

*Description.*—This little red-headed louse is very small, slightly exceeding  $\frac{1}{25}$ th of an inch when full grown. It is of a pale brownish colour, almost transparent, with the head more dense and reddish, body flattened, head broader than long, eyes outstanding, antennae short and three-jointed, legs short, thickset, and yellowish, with one terminal claw, eggs or "nits" fastened on to the wool, dirty

white, hatching in from six to eight days. The young reach sexual maturity in 16 to 18 days from hatching. Thus we have a complete life cycle every three weeks. The adult insect is apterous or wingless, and may lay 100 or more eggs.



Red headed Sheep Louse.  
*Trichodectes sphaerocephalus* (Nitzsch).  
× 50.

This louse is distinguished by the darker dorsal median bands on each of its abdominal segments, and is only found infesting sheep. It is commonly found near the skin, on the upper parts of the neck, shoulders, back, and thighs. When in great numbers on an animal in low condition, it will be found on all parts of the body.

#### SHEEP FOOT LOUSE.

(*Linognathus Pedalis*, Osborn.)

This insect has been discovered during the past year or two infesting sheep in several districts. As its name infers, it is found about the feet, fetlocks, and undersides of the legs towards the belly. It differs entirely from the previously described louse in size, shape and mouth parts.



Sheep Foot Louse, *Linognathus pedalis* (Osborn).  
× 50 Male. × 50 Female.  
(Original.)

Its mouth parts are adapted for piercing the skin and sucking the blood of the host animal. It follows, therefore, that should it become abundant upon an animal, the injury would be more severe than that caused by the biting lice which do not puncture the skin.

Fortunately, this pest is, so far as we know, confined to several isolated areas, whereas the biting louse is more or less widespread throughout the State. As far as I have been able to ascertain there does not appear to be any previous record of this insect in Australia. (*Haematopinus ovillus*) has been reported in New South Wales (see *Journal of Agriculture*, April, 1923). Judging, however, from the statement therein made that the eggs were found on the wool of the belly, legs, and thighs, I am of opinion that the louse then found is identical with the one herein recorded (*Linognathus pedalis*).

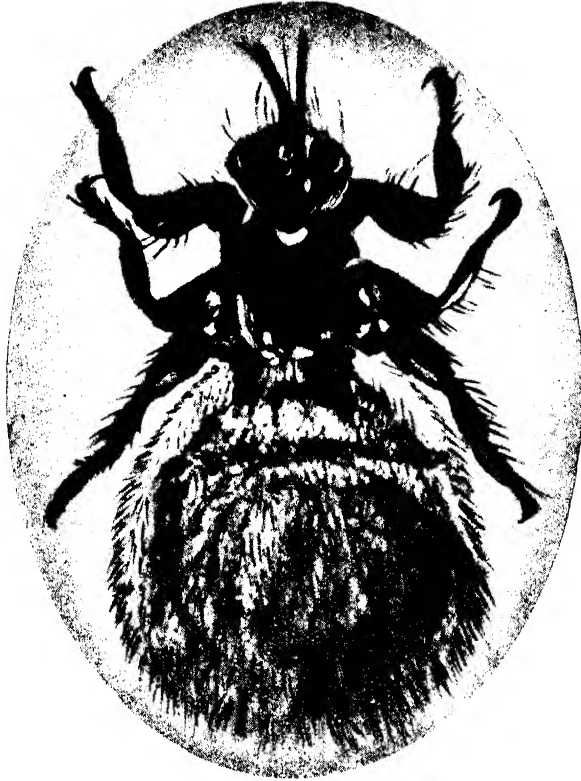


Portion of wool from flock of sheep, showing masses of louse eggs or "nits."  
(Original.)

*Description.*—The foot louse has a short head, as wide as it is long, which merges into the thorax, mouth parts for piercing or sucking. There are no eyes apparent. The antennae large, five-jointed, pointed, terminal joints with three or



four bristles. The body is about  $1/12$ th of an inch long and  $1/25$ th of an inch wide, being considerably longer and wider than the biting lice. The males are broader and flatter than females. The legs are strong and terminated with a powerful claw. Anterior or front pair smallest, posterior pair largest. The white eggs



The Sheep Tick—Female.  
*Melophagus ovinus* (Linn.).  
× 13. (Original.)

or "nits" are attached to the wool on lower part of leg and foot, a short distance from the skin. They take slightly longer to hatch, but otherwise the life history is very similar to the sheep louse.

There are other lice infesting our pigs, horses, etc., but the purpose of this article is to deal only with those species infesting sheep.

#### THE SHEEP TICK.

(*Melophagus ovinus*, Linn.)

This so-called tick is not a true tick, but is a wingless parasitic fly which passes the whole of its life stages on the body of the sheep. There are various vernacular names attached to this insect, namely "Ked," "Louse Fly," and "Sheep

Tick." It is a blood-sucking insect that is now widespread in many sheep-producing countries, and is certainly well established and widespread throughout the flocks of this State.

This wingless fly belongs to the great Order of *Diptera*, *Family Hippoboscidae*, *Genus Melophagus*. This insect is curious in that it does not lay eggs as do most *Diptera* or flies. The egg is retained within the body of the mother, hatches therein, the larva becoming full grown. It is then given birth to, enveloped in a soft membrane, which quickly hardens into a shell around the larva, forming what is called a puparium, wherein it pupates. The larval stage of this fly does no harm whatever, the blood-sucking habit of the adult being the cause of all the trouble. The pupa is attached to the wool by a glue-like substance. These shell-like pupæ are in error called eggs.



Pupa of Sheep Tick, in error called the egg.

In from 20 to 25 days after being deposited the pupa is broken open by the tick, which emerges and becomes at once an active blood sucker. Four to six days later it reaches sexual maturity, and 10 to 12 days later the female deposits her first pupa. Each female is capable of depositing several pupæ. We therefore have the following life cycle egg and larval stage within the mother seven to 10 days, from birth of larva enveloped in soft pupa case to emergence of tick 20 to 25 days, in 12 to 14 days after emerging from the pupa the female is depositing her first pupa. The life cycle is completed every 39 to 49 days.

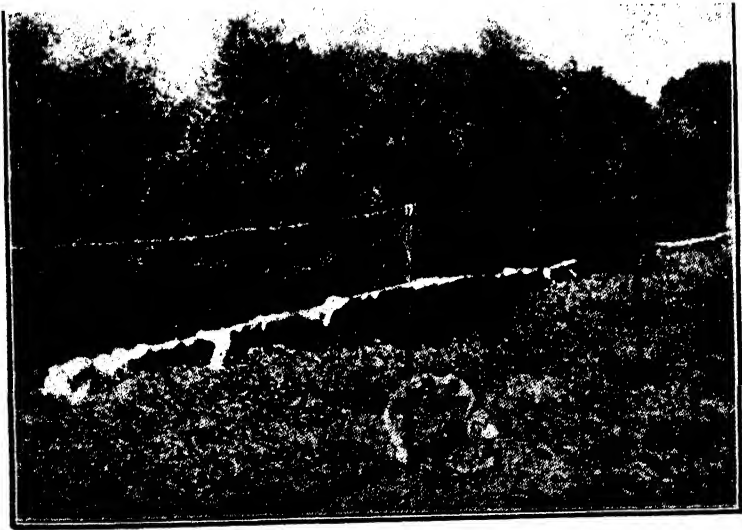
In treatment, therefore, it is necessary to repeat the dipping 20 to 25 days later, thus destroying any ticks that may have emerged from pupæ which resisted the first treatment.

*Description.*—As before stated, this insect is not a true tick, but is a wingless fly. It has six legs, whereas the true ticks have eight when adult. The mouth parts are very similar to those of other blood-sucking flies. The legs are fairly long, strong, and terminated with two powerful long claws. The antennae are unobservable. Upon the head may be seen a pair of stout stylets, the piercing mouth structures, which are tipped with several strong hairs. The adult is about a quarter of an inch long, of a reddish or grey-brown colour. The body is distinctly divided into head, thorax, and abdomen, which again distinguishes them from the true ticks, which have the thorax and abdomen fused, with a very inconspicuous head. The forepart of the body is uncommonly small. The abdomen is, however, proportionately very large, especially when the insect is well gorged with the blood of its host

or is carrying a well-developed pupa. They have a rapid motion when disturbed, running rapidly forward or sideways and backwards like a crab. The neck, breast, shoulders, belly, and thighs are the favoured locations on the host.

*Injury.*—This parasite, like the blood-sucking lice, lives upon the blood of sheep, which it obtains by sinking its sucking tube into the flesh.

When numerous they cause great irritation, loss of blood, interference with feeding, with consequent loss of condition and vitality. The sheep, when brought to this condition, are then unable to resist other diseases. The wool is lowered in value owing to its being soiled with the excreta and matted together with pupae. The sheep also scratch, bite, and rub themselves, causing the fleece to become ragged and broken in staple. The lambs of the flock suffer most from the ravages of this pest, and, if they become heavily infested, receive a set-back at an important period in their development.



Infested wool clinging to wire fence after sheep have been scratching.

*How the pest is spread.*—Although this insect does not seem to possess the instinct of migration to any extent and cannot fly, nevertheless, once introduced into a flock it soon spreads. This is particularly so where sheep are frequently herded or yarded. When in contact with each other the tick readily passes from one animal to another. There are other means of spreading, such as on dogs or other animals which have come in close contact with infested sheep. Men working amongst infested sheep sometimes carry the parasite on their clothing, and may thus be the means of introducing them into a clean flock. Scratching posts, fences, wires, trees, etc., against which the sheep have rubbed and dislodged some infested wool may be the medium of conveying the pest to a clean sheep should same come in contact. If tick is suspected, part the wool over the neck, breast, shoulders, belly, and thighs, when they will be readily detected (Fig. 5).

In the interests of the sheep and wool industry, it behoves all owners to make themselves acquainted with these external parasites, so that they can recognise these pests in their initial stages of introduction to the flock. The next step is to take prompt and correct measures for their treatment, and if possible, eradication.



Wool on neck of infested sheep parted, showing ticks and pupae.

## REGULATIONS UNDER "THE STOCK DISEASES ACT, 1895." Compulsory Dipping Area.

### PART VI.—SHEEP AFFECTED WITH TICK OR LICE.

*All sheep in South-West Division of the State to be dipped.*

54. (1) Unless otherwise authorised by the Chief Inspector of Stock every owner of sheep within the boundaries of the South-West Division of the State shall on or before the 1st day of February in each year dip or cause to be dipped in a swim bath prepared from some specific known to be fatal to ticks and lice all sheep running upon land whereof he is the owner or occupier Provided that, in

the case of sheep in the Armadale, Murray, Harvey, Drakesbrook, Bunbury, Dardanup, Donnybrook, Balingup, Greenbushes, Bridgetown, Warren, Nannup, Capel, Busselton, and Augusta Road Districts, as constituted under "The Road Districts Act, 1919," it shall be sufficient for the purposes of these regulations if the requirements of this paragraph are carried out on or before the 31st day of March in each year.

(2) If any sheep affected with tick or lice shall be found upon any property on which sheep are grazed, the owner or occupier of the land on which the affected sheep are depasturing shall be guilty of an offence against this Act, and any inspector may give notice to the aforesaid owner or occupier of the land on which the affected sheep are depasturing to dip or dress the sheep forthwith in such manner and at such place as the inspector of stock may direct, and every such owner or occupier who refuses, neglects, or fails to comply with the aforesaid notice shall be liable to a further penalty.

(3) No sheep affected with tick or lice shall be offered for sale privately or by auction or removed from the property on which the sheep are being depastured until they have been dipped in some specific known to be fatal to tick and lice, provided that permission may be granted by the inspector to remove them to an approved dipping place.

*Sheep infested with Tick or Lice must be dipped.*

55. (1) If an inspector is satisfied that stock depasturing in any part of the State is affected with tick or lice, he shall give the owner thereof notice to dip such stock forthwith to the satisfaction of the inspector or his agent.

And any owner who refuses, neglects, or fails to comply with such notice on or before the date specified therein shall be liable on conviction to a penalty not exceeding fifty pounds for the first offence, and if immediately after conviction for the first offence such stock shall not be dipped to the entire satisfaction of the inspector, such owner shall upon conviction be liable to a further penalty not exceeding fifty pounds, and so on for each and every succeeding conviction.

(2) If any sheep affected with tick or lice shall be found in any pound, or in any yard or yards, or on any land or other place at which sheep are offered for sale or exhibited for show purposes, the owner exposing the sheep so affected shall be liable to a penalty not exceeding fifty pounds, and an inspector, if he deems it necessary, may order the withdrawal from sale of any sheep affected with tick or lice until such sheep have been dipped or dressed to the satisfaction of such inspector or any other inspector, and may give notice to the aforesaid owner of such sheep to dip or dress the same forthwith, at such place as the inspector may direct; and every such owner who refuses, neglects, or fails to comply with the aforesaid notice shall be liable to a further penalty not exceeding twenty pounds. But if the inspector is satisfied that such sheep are intended for immediate slaughter, he may withhold such notice to dip.

*Stud Sheep.*

56. Every owner, occupier, or person in charge of any holding in the South-West Division of the State shall, before the removal of any stud sheep, make a statutory declaration, according to Form No. 8 in the Third Schedule hereto, that such sheep are free from tick and lice. If such sheep are found to be suffering from tick or lice, such owner, occupier, or person in charge shall cause them before

removal to be dipped in a swim bath prepared with some specific known to be fatal to tick and lice, and shall make a declaration, according to Form No. 9 in the Third Schedule hereto, that they have been so dipped.

*Statutory Declaration to be supplied within fourteen days after dipping.*

57. Within fourteen days after the dipping of his sheep the owner shall make a statutory declaration before a justice of the peace, to the effect of Form No. 10 in the Third Schedule hereto, stating that he has dipped his sheep in accordance with the provisions of these regulations, the date of dipping, the number of sheep dipped, and the class of dip used, and he shall forward such declaration to the Chief Inspector of Stock.

*Ewes with lambs—time for dipping.*

58. Notwithstanding anything contained in these regulations, it shall not be necessary to dip ewes affected with ticks or lice during such time previous to or after their lambing as the inspectors may appoint, and for such purpose any inspector may, in respect of such ewes, extend any notice to dip for such time as he shall think fit.

*Permits to move sheep in the Gascoyne.*

59. (1) Every owner of sheep in the area hereinafter defined must, before travelling or removing or causing to be removed, or attempting to remove, any sheep to any place outside the said area, obtain a permit to remove such sheep from an inspector of stock, who shall not issue the said permit unless he is satisfied that the sheep intended to be so removed out of the prescribed area are free from parasites known as tick and lice; and every person contravening this regulation by act or omission shall be punishable summarily, and upon conviction be liable to a penalty not exceeding one hundred pounds and not less than fifty pounds.

(2) The area referred to is that portion of the State bounded on the South by the Northern boundary of the South-West Division, commencing at the sea-coast and proceeding as far as the intersection of such boundary with the 115 degrees 5 minutes East longitude; thence following such meridian Northerly to the intersection of the sea-coast; thence along the sea-coast to the starting point.

*Affected Stock not allowed to stray.*

60. Every person who by himself, his agent or servant, drives, without the permission of an inspector, or suffers to stray across or upon any land, or drives, depastures, or suffers to stray upon or along any highway any sheep which have not been dipped according to these Regulations, or which are affected with ticks or lice, shall be liable on conviction to a penalty not exceeding Fifty pounds.

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## THE CLEANSING OF DAIRY UTENSILS.

G. K. BARON-HAY, Superintendent of Dairying.

With the advent of warm weather conditions a rapid falling off has been noticed in the percentage of first-grade creams received at some factories. This is particularly the case where the cream is being drawn from areas from the Great Southern Railway eastwards, and it is interesting to note that the cream being received from these areas has increased approximately 50 per cent. during the last season over the previous year.

It is becoming increasingly difficult to market butter made from such inferior supplies, and factories are being placed in embarrassing positions due to the necessity of handling such cream.

Recent investigations by officers of the Dairy Branch have shown that there are two main causes for the faults in most inferior creams now being received.

(a) Staleness, leading to development of undesirable taints.

(b) Unclean conditions in handling milk and cream.

(a) *Staleness*.—The remedy for this cause is obvious, namely, to forward the cream more often to the nearest factory. Where only a few cows are being milked, and the quantity of cream to be forwarded is small, the temptation to delay despatch till the can may be full is strong, but almost invariably unprofitable.

The loss on only two pounds of butter fat through being graded second grade is not less than 8d., and may be as high as 1s., which is sufficient to pay the rail-age on the can to the nearest factory. The necessity of frequent consignments has been recognised by the Government in the provision of special concession freight rates on cream over the railways.

(b) *Cleanliness*.—Far more serious defects in cream, however, are caused by unclean methods in handling, and the effect of such conditions very soon becomes apparent in hot weather. It is essential that absolute cleanliness be observed in all dairy work, and the first axiom is to have clean sterile utensils in which to handle the milk and cream.

The only method by which this desirable condition can be obtained is by the provision of adequate washing, and, if possible, steam sterilisation of all equipment. In factories steam sterilisation is always practised, but on farms the necessary boiler machinery is not always possible.

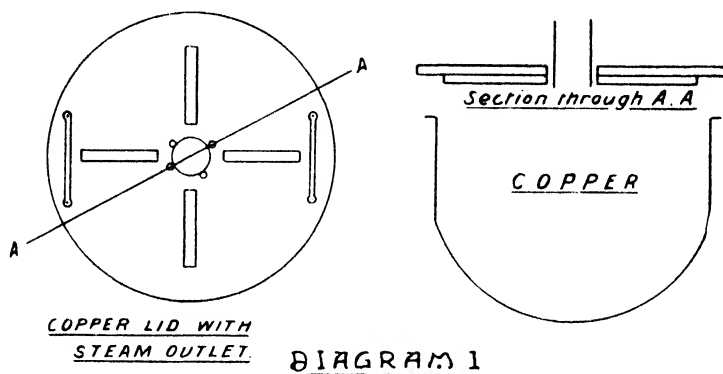
A very cheap, but effective, means by which utensils may be properly washed on farms was published by the National Institute for Research in Dairying in 1923, and is applicable, with modifications, on dairy farms in this State where not more than 20 cows are in milk at once.

In cleansing dairy utensils, three processes are necessary, as washing alone will not thoroughly clean, neither will steaming alone. One is complementary to the other.

1. Washing with warm water to remove curdy portion of sediment on buckets, etc.

2. Washing and scrubbing with hot water containing soda, or some recognised dairy cleansing material.
3. Sterilisation by steam.

To perform the third operation, a very simple "steamer" is described below.



*Drawing by W. A. Hoy, from the National Institute for Research in Dairying.*

### STERILISATION OF BUCKETS, CREAM CANS, ETC.

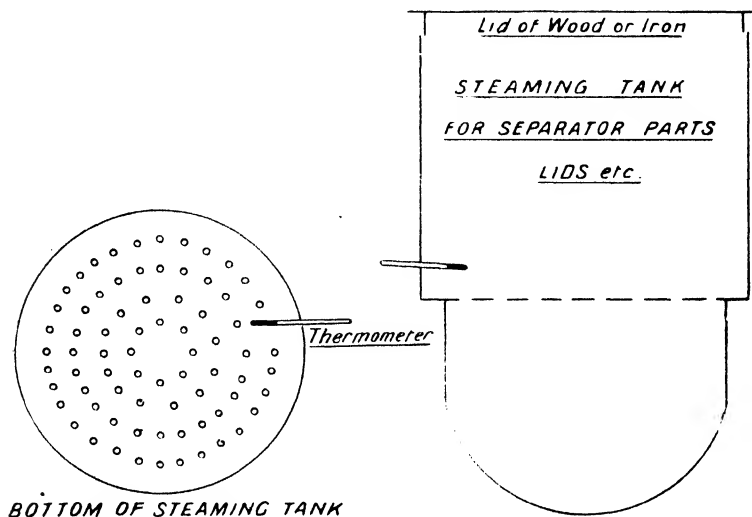
An ordinary copper may be used for this purpose in the following way:— A lid which will fit flat on the top of the copper should be made. (See Diagram 1.) A hole about  $2\frac{1}{2}$ in. in diameter is cut in the centre of the lid, and a metal tube or tin with the bottom removed is fixed in the hole, fitting tightly, so that it projects about 3 inches, and four pieces of thin wood are fixed on the top side of the lid so that the buckets will not rest directly on the flat surface of the lid, and prevent the steam from escaping. It will be found that the steam from an ordinary copper concentrated through the metal tube will effectively sterilise buckets, cream cans, etc. Several small holes,  $\frac{3}{8}$ in. diameter, may be bored in the lid near the tube so as to allow any condensed steam to flow back into the copper.

### METHOD OF STERILISING BUCKETS, CANS, ETC.

After the water has been removed to wash the utensils, the copper is replenished and the water made to boil vigorously, the lid having been placed in position. Buckets may then be inverted over the metal tube for sterilisation. Provided the copper is boiling actively throughout the period, the time required to sterilise a 10-gallon can is four minutes; a 5-gallon or less, can or bucket, will require three minutes from the time of placing over the steam outlet. The time may be gauged by the following rough but practically efficient method. It will be noticed that the rim of the can next the lid will be the last part of the bucket to become hot. When this is too hot to be held, a further minute will complete the sterilisation.



The buckets may be laid on their sides, and will rapidly dry. *On no account should an attempt be made to dry the inside of the cans, etc., with a rag.* After the lids have been churned they should be placed on their cans. Buckets should be placed in the dairy free from dust ready for use.



**DIAGRAM 2.**

*Drawing by W. A. Hoy, from the National Institute for Research in Dairying.*

### STERILISATION OF SEPARATOR PARTS, STRAINER, ETC.

For these utensils a box or tank which will fit over the top of the copper will be required. An ordinary round galvanised water tank will suffice, the diameter being slightly wider than that of the copper, so that the copper will be covered when the tank is placed over it. A well fitting lid of wood or iron will be required for the tank, and two handles should be provided for lifting when hot. The bottom of the tank must be perforated with a number of 1 in. holes to allow steam to gain access to the tank. The size of the tank should be sufficient to take the utensils to be treated, but a large tank is undesirable. (Diagram 2.)

The steaming of all utensils which cannot be done over the steam pipe can be done in the tank. The steaming period will vary according to the quantity of material to be heated in the tank, and also by the rate at which the water boils, so it is desirable to insert a thermometer through the side of the tank, taking care that it does not protrude over one of the holes in the bottom, or a higher temperature will be recorded than is that of the tank.

When the thermometer records 210deg. F. (just below boiling point of water), a period of fully five minutes will be required for sterilisation. When the water in the copper boils vigorously, a period of about 10 minutes will be required to bring the tank and its contents up to 210 degrees.

The writer is convinced that by the adoption of one of the methods of cooling cream suggested in the *Journal of Agriculture*, Vol. 7. No. 4, December, 1930, and the sterilisation of all dairy utensils at least once a day when in use, the production of choice cream will become an accomplished fact on not only dairy farms in the cooler portions of the State, but also on the Wheat Belt, where during the summer months the bulk of the cream being produced has developed undesirable flavours by the time it reaches the factory.

## THE APPLE TREE AND ITS FOOD.\*

GEO. L. SUTTON, Director of Agriculture.

During the past 40 years a large amount of research has been carried out in connection with the study of the principles which underlie the nutrition of fruit trees. During the first 30 years the work undertaken was mainly by field experiments modelled on the type adopted by Lawes and Gilbert in their investigations in agricultural crops at Rothamsted.

The results of the numerous earlier experiments—largely American—designed to ascertain in what manner fruit trees would respond to the application of commercial fertilisers, unlike those carried out with agricultural crops, were singularly disappointing and often contradictory.

Pot experiments, designed to study deficiency effects upon the tree and its crop, were initiated by Wallace at Long Ashton, and are still being carried out there, at East Malling and elsewhere; these are giving horticultural workers a much clearer idea of the underlying principles of fruit tree nutrition.

W. H. Alderman, in a paper entitled "The Status of Orchard Fertilisation Experimentation" in 1919 stated, *inter alia*:—

"There are apparently a great many orchards growing upon a variety of soils that will not respond economically to the application of any form of commercial fertiliser, nor of manure. This fact is well established by the work in New York, New Hampshire, Maine, West Virginia, and other States.

"Orchards under starvation conditions usually give a ready response to fertilisation when other treatments (culture, pruning, spraying, etc.) remain unaltered. This is well demonstrated by some of the Ohio, Oregon, and West Virginia experiments.

"Nitrogen in a readily available form seems to be the only element of plant food that is uniformly a factor in favourable responses when such are secured."

The first conclusion of Alderman that there are a great many orchard soils which do not respond economically to the application of any form of commercial fertiliser is to some extent supported by the results of a field experiment with blocks of manured and unmanured apple trees conducted at East Malling Research Station for eleven years commencing in 1919. The results show that the effects of the gradual depletion of plant food by the annual withdrawal of that required by the tree and its crop are not at once apparent, for in reporting upon the respective condition of the two blocks the investigator states:—"As has been pointed out, at the time of planting the trees in the starved (unmanured) plot were, if anything, somewhat sturdier than those in the fully manured plot and during the next five years season's growth the only differences in vigour of which it is possible to be certain are in favour of the unmanured plot."

Such results, which are, no doubt, in line with those of many W.A. orchardists, illustrate the difficulty of obtaining information regarding the effect of fertilisers upon fruit trees by means of short term field experiments. They may also cause some orchardists to form the conclusion that manuring good orchard land is unnecessary. It is believed that such a conclusion is erroneous and requires to be

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\* An illustrated lecture given at a meeting of Bridgetown Fruit Growers' Association, 5th December, 1931.

guarded against. It is true that the effects of the gradual depletion of plant food are not at once apparent, but it is none the less real, for the tree cannot grow or produce fruit without using some of the plant food in the soil, and experiments conducted at Long Ashton and East Malling in connection with "Leaf Scorch" show how unwise and unbusinesslike it is to allow the depletion of plant food to go on until its effect is noticeable. "Leaf Scorch" is a disease now known to be due to a potash deficiency, and though heavy potash fertilisation was applied to remedy it, it was not until four years or more after the first application that any improvement was noticed, and even ten or twelve years later the trouble may not be entirely corrected.

From the work done and the mass of experimental data collected, certain conclusions have emerged and are available for the guidance of the practical orchardist in W.A. These are:—

1. That on naturally fertile land there is a lack of an immediate response to the application of fertilisers.
2. That it is important to keep the orchard land in "good heart," i.e. in good tilth and capable of producing reasonably good cover crops.
3. That it is important to apply potash fertilisers even when, with our present knowledge, there is no apparent indication of a potash deficiency.

Apart from cultural methods, obviously therefore a fundamental feature of successful horticultural practice will involve a fertiliser programme which aims—

- (a) to remedy any natural plant food deficiencies in the soil at the time of planting, and
- (b) to add to the soil such nutrient constituents as may be removed by the fruit and tree growth.

It may further involve the application of additional fertilisers in order to secure satisfactory or indeed maximum growth of cover crops, which in Western Australian orchards are essential to secure the maintenance of tilth, and to prevent the possible winter leaching of nitrogen.

In common with other agricultural plants, the apple tree and its fruit contains a very large percentage of water. It is regretted that no Western Australian or Australian analyses have been obtained, but according to Roberts\* the amount of water in American apples amounts to 85.3 per cent. and rather less, 83.1 per cent., in German apples. Of the 14.7 per cent. dry matter found in the American apples, there is .13 per cent. of nitrogen and .39 per cent. of ash, a total of .42 per cent. only obtained from the soil, the balance being formed mainly from the carbonic acid gas in the air by means of the process known as carbon assimilation. The elements essential for the growth of plants are seventeen in number and are:—Hydrogen, oxygen, carbon, nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, iron, manganese, silicon, aluminium, iodine, boron, copper and zinc. Of these the first three are obtained from the air, of which there is an abundance over every orchard, good or bad, and from these some 96.5 per cent. of the dry matter is formed. The constituents containing the remaining fourteen elements are derived from the soil, which therefore provides only about 3.5 per cent. of the dry matter found in the apple. Though these elements provide such a small quantity they are all important and each is indispensable to the tree, for if one is deficient the others do not function properly, and the tree is unable to thrive.

\* The Fertility of the Land—I. P. Roberts, 1897.

Fortunately, however, the orchardist, working under normal conditions, need only consider three of these elements, viz., nitrogen, phosphorus, and potassium, as important in connection with his fertiliser practice. The others are usually found in such abundance in the soil or in combination with one or more of the other constituents supplied by commercial fertilisers that the food requirements of the plant are met without special application to supply them. Indeed, until recently the last-named seven were not regarded as necessary for the well-being of plants, and their need has only been discovered consequent upon the more delicate tests now possible being applied. Of this group manganese has probably received the most attention in this State. In 1927 Carne\* drew attention to the deficiency of available manganese in certain soils in the Dwarda district of this State, and in consequence of which the oat and wheat crops growing upon them suffered from a disease known as "Grey Speck." Other recent researches in Europe, the United States, and South Australia have shown that manganese is an essential element for plant growth, and the lack of available manganese is found to be a factor in causing plant disease and to be responsible for poor crop yields on certain types of soil. Schreiner† reports that in the swamp districts of Florida, known as the "Everglades," it was originally impossible to grow tomatoes on these soils with the application of commercial fertilisers only and unless a dressing of stable manure brought from outside the area was also applied. It was ascertained recently that the imported stable manure was supplying a deficient element, manganese, and now the application of soluble manganese in the form of sulphate of manganese cures the trouble, leads to the production of normal crops, and has rendered unnecessary the application of stable manure.

As far back as 1923 Wickens‡ obtained evidence that, under some conditions, copper was essential to the welfare of citrus trees. Since then copper has also been found essential for citrus and other fruit trees in New South Wales and U.S.A.

In this State it is customary to state the percentages of nitrogen, phosphorus, and potassium contained in manures and commercial fertilisers as nitrogen, phosphoric acid, and potash, and also in some cases to use their chemical symbols in lieu of the names, thus N for nitrogen,  $P_2O_5$  for phosphoric acid, and  $K_2O$  for potash.

In Table 1 will be found the percentages of nitrogen, phosphoric acid, and potash found in the apple tree and fruit as given by Roberts.§ The difference between the analyses of American and German fruit will be noticed at once, and though it is considered that the American figures will be more nearly approximate Australian, it is obvious that the analyses must be regarded and discussed in a wide and comparative, rather than in a restricted, manner. The striking features of these analyses are the relatively large proportion of potash in the fruit and similarly the relatively large proportion of nitrogen in the leaves. This latter may account for the consistent response to nitrogenous fertilisers referred to by Alderman and already quoted.

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\* Journal Agric., W.A., December, 1927—"Grey Speck Disease of Wheat and Oats."—W. M. Carne.

† Some New Factors in Fertilizer Practice—O. Schreiner, "The American Fertilizer," July 5th, 1930.

‡ Exanthema of Citrus Trees—G. W. Wickens. The Proceedings of the Imperial Botanical Conference, London, 1930.

§ The Fertility of the Land—I. P. Roberts, 1897.

TABLE 1.

*Percentages Water and Fertiliser Constituents Found in the Apple Tree and Fruit (Roberts).*

Part of Plant.	Water.	Ash.	Nitrogen (N).	Phosphoric Acid (P <sub>2</sub> O <sub>5</sub> ).	Potash (K <sub>2</sub> O).
Leaves (Spring) ... ..	72.3	2.33	.74	.25	.25
" Autumn ... ..	60.7	3.46	.89	.19	.39
Fruit (American) ... ..	85.3	.39	.13	.01	.19
" (German) ... ..	83.1	.22	.06	.03	.08
Branches ... ..	83.6	.65	...	.04	.04
Trunk ... ..	51.7	1.17	...	.06	.06
Roots ... ..	64.7	1.59	...	.11	.09
Whole Plant ... ..	60.8	...	.35	.05	.17

The average amounts of nitrogen, phosphoric acid, and potash removed annually by 250, 500, and 1,000 cases per acre respectively, calculated from the data for American apples are shown in Table 2. As the weight of the leaves and branches produced annually by trees bearing these crops are not available, it has not been possible to make calculations of the amounts required for these portions of the tree. Roberts has, however, estimated the amounts which had been removed

TABLE 2.

*Estimated Average Yearly Fertiliser Requirements for Crops of 250, 500 and 1,000 bushel cases.*

				No. of Cases—			No. of Cases—			No. of Cases—		
				250	500	1,000	250	500	1,000	250	500	1,000
				Nitrogen.			Phosphoric Acid.			Potash.		
				lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Fruit	...	...	...	13	26	52	1	2	4	19	38	76
Leaves	...	...	...	...	23	...	...	7	...	...	22	...
Branches	...	...	...	...	14	...	...	6	...	...	13	...
Total	...	...	...	...	63	...	...	15	...	...	73	...

by the leaves and branches of trees during 20 years, these trees then bearing about 500 bushels per acre. These figures have been taken as representing those relating to a crop of 500 bushels, and are included in the table. Though a crop of this size is far greater than the average Western Australian crop, it is not an impossible one, and as it is the only one for which data are available, the fertiliser requirements of the Western Australian crops will be considered on this basis. From the figures in Table 2, it is estimated that the annual requirements of a 500-bushel crop are:—Nitrogen, 63 lbs.; phosphoric acid, 15 lbs.; and potash, 73 lbs.

In addition to the plant food removed by the apple tree and its crop, there have to be considered also the possible losses due to the essential cultural methods of good orchard practice. The work of the Rothamsted Experiment Station furnishes interesting information on this point. At that station it was found that from a piece of land five feet deep which, though kept free from weeds, was not cultivated, there was an annual loss during 23 years of nitrate nitrogen equal to

per acre, from 15 to 60 lbs. This was leached out and found in the drainage waters.\* The loss of this nitrogen was possible only because of the decomposition of the organic matter (humus) in the soil from which it was formed. The ground from which the loss occurred was uncultivated. Had it been cultivated, the losses would have been greater, because the natural agencies responsible for the decomposition of the humus would have been assisted by the greater aeration of the soil due to the cultural methods. Evidence on this point is furnished by studies on fallowed land in our Wheat Belt. It has been found on this land that much larger quantities of nitrate nitrogen accumulate in the soil during the spring and summer, hence there must have been a much greater destruction of organic matter than is the case at Rothamsted.

Good orchard practice in Western Australia involves clean cultivation during the summer, and it is obvious, therefore, that the destruction of the organic matter in the soil must proceed at practically a maximum rate. With warm weather and intense cultivation the organic matter is literally burned out. As the quantity of organic matter in the soil is lessened, its ability to withstand drought is reduced, and the difficulty of maintaining tilth of the heavier soils is increased. The organic matter is also the food for the soil bacteria which render available the food necessary for tree growth. It is, therefore, **as important to replace in the soil the organic matter destroyed by cultivation as it is to return the plant food utilised and removed by the tree and its crop.** This can be done readily by green manuring, *i.e.*, the growth of cover crops during the autumn and winter, and ploughing them or their residues in during the early spring. Such crops need not necessarily be sown ones, and in most cases will not be. The natural vegetation which springs up in the orchard when cultivation ceases and the autumn rains commence will usually supply all that is necessary for the purpose. If, however, this growth does not contain some legumes such as clovers and trefoils, and also some deep rooting plants, then seeds of these plants should be sown. Leguminous plants are necessary because, as most orchardists are now aware, these plants collect the free nitrogen of the air by means of the colonies of bacteria found in their roots, store it in the leaves, stems and roots, and as these decay in and become incorporated with the soil, its nitrogen content is increased. As a natural consequence a considerable saving in the fertiliser bills is effected. Deep rooting plants are advisable, because these will open up and aerate the subsoil; they also encourage deep rooting of the tree, for as the roots of the deep rooting cover plants decay the feeding roots of the tree will descend and feed upon the material thus made available. Very suitable plants for this purpose are the "White Mustard" (not wild mustard) and "Rape." The seed of both is comparatively cheap, and the former has the advantage that it is an extremely quick-growing plant, and will probably furnish a greater amount of organic matter in a shorter period than any other cultivated plant.

Though the pasturing of cover crops in the orchard is not advocated because of probable damage to the trees and the danger of the puddling of the heavy soils, it has to be pointed out that even when this is done, the addition of organic matter to the soil is considerable, and in most cases the amount of the three principal fertilising constituents removed by the grazing stock is small, that is, provided the grazing is not spasmodic but continuous, and the excreta resulting from the food eaten is returned to the soil.

The plant food contained in a cover crop is not available for the use of trees or other succeeding crop until it has decayed, and it will dry rather than decay

\* The Chemistry of the Farm (20th Edition)—R. Warrington.

if its ploughing is delayed so long that moisture in the soil in which it is buried is scanty or absent. It is, therefore, essential that the cover crop be ploughed in prior to the end of the rainy season, and as soon as it is possible to get on the ground in the spring, say prior to the end of August.

The growth of cover crops, their incorporation with the soil, and the addition of commercial fertilisers to supply the other plant food needs of the tree and its crop will keep the soil in that "good heart" necessary to secure optimum crops of fruit. Because the productivity of the tree is not dependent upon the immediate application of fertilisers as are annual crops, the character of the cover crop may be regarded as the indicator by which the fertiliser needs of the orchard may be judged. Whilst leguminous cover crops grow luxuriantly and potash fertilisers are applied, the signal may be considered to be set at "Safety."

Some of the sources from which the nitrogen requirements of the orchard can be obtained are shown in Table 3. Included amongst these are leguminous crops and farm-yard manure, and before considering the purchase of commercial fertilisers, the possibilities of both of these should receive the attention of the farmer.

TABLE 3.

*Some Sources of Nitrogen and Prices per Ton, W.A., 1931.*

Source of Nitrogen.	Composition.			Price per ton.
	Nitrogen.	Phosphoric Acid.	Potash.	
	%	%	%	
Leguminous Crops ... ..	55	...	...	£ s. d.
Farmyard Manure ... ..	36	...	...	
Sulphate of Ammonia ... ..	20.5	...	...	13 0 0
Nitrate of Soda ... ..	15.5	...	...	15 4 0
Nitrophoska ... ..	15.5	15.5	19.0	23 0 0
Diammonphos ... ..	20.6	53.0	...	40 0 0
Blood and Bone (A) ... ..	5.75	13.0	...	11 5 0
Blood and Bone (B) ... ..	6.0	9.0	...	12 10 0
Bonedust (A) ... ..	3.5	22.0	...	12 10 0
Bonedust (B) ... ..	2.75	18.3	...	10 15 0
Unit Values— $P_2O_5$ , 4/3 ; $K_2O$ , 4/10.				

The percentage of nitrogen shown as being present in leguminous crops is the average of those found in samples of Subterranean Clover collected at the end of August and at the period when a crop of this kind should be ploughed under. Five tons of such a crop would therefore supply about sufficient nitrogen to meet the requirements of the trees producing a 500-bushel crop of apples.

It will thus be seen that a good leguminous cover crop will provide all the nitrogen necessary for the growth of the tree and the production of its fruit.

The number of orchards using mechanical traction is increasing, but still most orchardists keep a cow and some poultry, and at least a little farm-yard manure is available. Whilst, no doubt, the vegetable and flower gardens have the first call upon this, its value in the orchard should not be overlooked. Its analysis shows that a ton contains 8 lbs. nitrogen, 6 lbs. of phosphoric acid, and the same quantity of potash, so that eight tons per acre will supply all the nitrogen requirements, and in addition, very much more phosphoric acid than is required and two-thirds of the potash needed. In addition, considerable further benefits accrue to the soil as the result of the organic matter it contains and possibly, as indicated by the experience in the Florida Everglades, it may also supply some of those trace-like but essential elements like manganese.

The fertilisers referred to in the table are fairly representative of the nitrogenous group on the local market, and it will be seen that there is considerable difference in their nitrogen content which ranges from 2.75 per cent. in the case of bonedust B to 20.6 per cent. in Diammonphos. These two fertilisers also represent the greatest range in price, from £10 15s. to £40. Neither the analyses nor the prices may have any relation to the agricultural value of the fertilisers. This is based upon two factors—the form in which the nitrogen is contained in the fertiliser and its cost per lb. or per unit. Nitrogen in fertilisers is in three forms, viz., organic, ammoniacal, and nitrate. For the purpose now being considered, the main difference between these is that the organic form is slower to act than ammoniacal, and this latter slower than the nitrate. Provided there is ample time in which to apply any one of these forms before its effect upon the tree is required, and usually under Australian conditions this is the case, all forms may be considered to have the same value. The orchard value of the nitrogen may therefore be considered to be in direct relation to its cost per lb. or per unit. A fertiliser “unit” is the conventional term used in valuing the constituents of fertilisers, just as a “stone” of 14 lbs. is a recognised term used in valuing and selling some other commercial commodities. A fertiliser unit is 1/100 or 1 per cent. of 1 ton (*i.e.*, 22.4 lbs.), and is used because the quantity of plant food contained in a commercial fertiliser is usually expressed in percentages, and it is thus very much easier and quicker to determine the value of a unit than that of a lb. In Tables 4 and 5 are shown the methods of calculating the price per lb. and per unit, and from a comparison of these methods it will be seen how much easier is the latter method.

TABLE 4.

*Cost of Plant Food per Lb.*

Sulphate of Ammonia, 20.5 %N.—Cost £13 per ton.  
There are 20.5lbs. of N. in 100lbs. of fertiliser.

“ „ 20.5lbs. „ „ 1lb. „  
100

“ „  $20.5 \times 2,240$ lbs. of N. in 2,240lbs. or 1 ton of fertiliser.  
100

=459.1lbs. of N. in 1 ton of fertiliser costing £13.

459.1lbs. N. cost £13.

1lb. N. „ £13 ÷ 459.1

1lb. N. „ 6.8d.

TABLE 5.

*Valuation of Fertilisers.**Cost of Plant Food per Unit.*

One Unit = 1/100 or 1% of 1 ton.

Sulphate of Ammonia, 20.5% N. costs £13 per ton.

20.5 Units in 1 ton cost £13.

1 Unit costs £13 ÷ 20.5

1 Unit costs 12/8

The calculations given relate to a simple fertiliser, sulphate of ammonia, but all the fertilisers supplying nitrogen, and shown in Table 3, are not simple. Nitrophoska, for instance, is a compound fertiliser containing phosphoric acid and potash in addition to nitrogen.

Before the cost of a “unit” of nitrogen can be determined in this or similar fertilisers, it is necessary to deduct from its price per ton the value of the other constituents—phosphoric acid and potash—which the fertiliser also contains. For



this purpose, and in this instance, the unit cost of these ingredients is ascertained from the market prices of the simple fertilisers. Superphosphate and muriate of potash will supply respectively phosphoric acid and potash. The unit values are calculated to be 4s. 3d. and 4s. 10d. respectively for  $P_2O_5$  and  $K_2O$ . Using these figures for Nitrophoska, it is found that—

	£	s.	d.
15.5 units $P_2O_5$ , at 4s. 3d., cost .. ..	3	5	11
19.0 units $K_2O$ , at 4s. 10d., cost .. ..	4	11	10
	<hr/>		
	£7	17	9

When this total is deducted from £23, the cost of the nitrogen is Nitrophoska is found to be £15 2s. 3d., representing the cost of 15.5 units of nitrogen at 19s. 6d. per unit.

Dealing with the other compound fertilisers in a similar manner, it is found that the relative costs of nitrogen per unit are as follow:—

Sulphate of ammonia—12s. 8d.
Nitrophoska—19s. 6d.
Nitrate of soda—19s. 7d.
Diammonphos—27s. 11d.
Blood and bone (A)—29s. 6d.
Blood and bone (B)—35s. 4d.
Bonedust (A)—44s. 9d.
Bonedust (B)—49s. 11d.

It will thus be seen that the cheapest form in which to buy nitrogen is in sulphate of ammonia, and at a price which is about a quarter that of the most expensive form, Bonedust (B).

Our climatic conditions are favourable to fairly quick nitrification in the spring, and in consequence the organic nitrogen in the soil following the ploughing in of a luxuriant cover crop in *early* spring should be quickly converted into the readily available nitrate form. It is difficult to realise, therefore, that under such conditions there will be any need to supplement the nitrogen supplied by the cover crop with applications of a quick-acting fertiliser.

Some American experiments in connection with the setting of the fruit of apples and pears indicate a possible advantage following a spring dressing of a quick-acting nitrogenous fertiliser. The results are shown in Table 6 hereunder.\*

TABLE 6.

*Influence of Nitrate of Soda Applications upon Set of Fruit in Two Hood River (Oregon) Apple Orchards.*

—	No. of blossoming spurs.	Percentage of fruit set June 4.	Percentage of fruit set Sept. 30.	Average Yield per. tree (bus.)
First Orchard—				
Check (unfertilised) ... ..	483	35.3	16.4	3.75
Fertilised with Nitrate ... ..	542	68.0	30.7	21.50
Second Orchard—				
Check (unfertilised) ... ..	386	9.0	4.6	1.33
Fertilised with Nitrate ... ..	620	58.0	15.1	9.50

\* Fundamentals of Fruit Production—Gardner, Bradford and Hooker, 192

In view of the American results obtained, and in the absence of any definite Australian data on this point, it is deemed advisable to recommend an application of nitrogen equivalent to 1 cwt. of sulphate of ammonia to be applied so as to be available when the buds are opening. It is suggested that if nitrate of soda (1½ cwt.) is used that it be applied about a fortnight before the expected date of flowering; if sulphate of ammonia, 1 cwt., about a week earlier, and if blood and bone or some other organic form about another week earlier still.

Some workers have advanced the opinion that with trees which have acquired the habit of biennial bearing, the application of a heavy dressing of nitrogenous fertiliser in the year of heavy bearing will tend to correct the habit for the following year. Whether this opinion eventually proves sound or otherwise, there is no reason to advocate the application of nitrogenous fertilisers to trees in their off-bearing season.

In the results of some experiments carried out by Teakle and Burvill\* on fallowed land at the Merredin Experiment Farm in the wheat area, it is shown that the effect of maintaining a clean fallow, as is the case in every well-cultivated orchard, was to have available in the soil in the autumn (19th April) a large amount of nitrate nitrogen. This amounted to 181 lbs., and was nearly equal to the amount supplied by 9 cwt. sulphate of ammonia. Information is not available regarding the amount of nitrate nitrogen produced in the fallowed land of a well-cultivated orchard. It is reasonable to suppose that, in connection with the decomposition of organic matter, a similar position would obtain and a large amount of nitrogen made available. It is to be expected that some would be used by the tree roots so that there would not be such a large accumulation of unused nitrogen as in the case of the wheat fallow, but there would seem to be no need to apply a dressing of nitrogenous fertiliser to the orchard in the autumn provided a good cover crop has been grown the previous year, and opportunities offered for its decay by ploughing in early. The possibilities of quantities of available nitrogen being available in the soil in the autumn do, however, indicate the need for the early growth of a cover crop so as to prevent the leaching of the nitrogen not utilised by the tree roots. Unlike phosphoric acid and potash, nitrogen is not stored in the soil, but is very readily lost.

In Table 7 are shown some of the sources of phosphoric acid, together with their composition and cost.

TABLE 7.  
Sources of Phosphoric Acid—W.A., 1931.  
Relative Costs per Ton.

Sources of Phosphoric Acid.	Nitrogen.	Composition Phosphoric Acid.			Potash.	Price per ton.
		W.S.	C.S.	A.S.		
Farmyard Manure ... ..	·36	·27	...	...	·27	
Superphosphate, 22% ... ..	...	20·5	·5	1·0	...	£4 10s.
Nitrophoska ... ..	15·5	15·5	...	...	19·0	£23.
Diammonphos ... ..	20·6	53·0	...	...	...	£40.
Blood and Bone (A) ... ..	5·75	...	...	13·0	...	£11 5s.
Blood and Bone (B) ... ..	6·0	...	...	9·0	...	£12 10s.
Bonedust (A) ... ..	3·5	...	...	22·0	...	£12 10s.
Bonedust (B) ... ..	2·75	...	...	18·3	...	£10 15s.
Rock Phosphate ... ..	...	...	...	36·6	...	£4 11s. 6d
Unit Values—N = 12s. 8d.; K <sub>2</sub> O						
4s. 10d.						

\*Fallowing for Fertility—Journal of Agriculture, W.A., March, 1930.

Phosphoric acid in manure and fertilisers is found in three forms, known respectively as water soluble, citrate soluble, and acid soluble. The first, as its name implies, is soluble in water, and is the most readily available to plants; the second is soluble in weak acids, and has almost the same agricultural value; the third is very much slower in action, its availability for the plants' use depending upon its fineness of grinding in the case of the mineral or rock phosphate, and the rate of decay in the case of the organic fertilisers, bonedust and blood and bone.

The principal phosphatic fertiliser in Western Australia is superphosphate, and this is valuable mainly because of its water soluble phosphoric acid; the unit value of this has been determined by ascribing an arbitrary value of 1s. per unit to the acid soluble phosphoric acid and to the citrate soluble phosphoric acid 80 per cent. of the value of the water soluble form. The unit value of the phosphoric acid in other fertilisers was determined as in the case of nitrogen contained in compound fertilisers. As the result of these calculations, the following are found to be the relative costs per unit:—

Rock phosphate—	2s. 6d.
Superphosphate, 22 per cent.—	4s. 3d.
Bonedust (A)—	9s. 4d.
Bonedust (B)—	9s. 10d.
Diammonphos—	10s. 2d.
Nitrophoska—	11s. 1d.
Blood and bone (A)—	11s. 8d.
Blood and bone (B)—	19s. 4d.

It is quite possible that, for the nutrition of the fruit trees, the slower acting forms of phosphoric acid, even that of the rock phosphate, if very finely ground, would be satisfactory; but as has been pointed out, the growth of the winter cover crop is an *all important* feature of orchard practice, and quite as an important a feature as the application of the fertiliser itself, and therefore the suitability of the fertiliser for promoting the growth of the cover crop is of prime importance.

Superphosphate has proved an excellent fertiliser for producing maximum results with leguminous cover crops in the orchard districts of the State. It can therefore be regarded as a very suitable orchard fertiliser for supplying phosphoric acid. It has the advantage that it is much cheaper, the relative unit cost being less than half that of the cheapest of the other soluble forms and less than one quarter the cost of the most expensive and slower acting form, blood and bone (B).

Though it has been calculated that about 75 lbs. of superphosphate will supply the phosphoric acid needs of an acre of apple trees producing a crop of 500 bushels, it is believed that this amount will hardly be sufficient to ensure maximum results with a leguminous cover crop, and hence it is recommended that this amount should be increased to whatever quantity experience or trial indicates is desirable. This is likely to be at least 1 cwt. per acre and in some cases 2 cwt., or even more. It should be applied in the early autumn. These amounts of superphosphate will also supply the additional amount of phosphoric acid indicated as desirable by the German analyses of fruit as given in Table I.

Though the phosphoric acid is the water soluble form, there need be no fear that it will be washed out. When superphosphate is applied to the soil the water soluble phosphoric acid it contains is washed into the soil by the first rains, after which a reaction takes place, and it is precipitated in a very fine state of division

and throughout the soil: Though available for the use of the plant, it is not leached out, but, as was found at Rothamsted, any surplus not used by the plant accumulates in the layer of soil stirred by the plough.

At this stage it is opportune to refer to the question of lime. It may be asked "What is the need for lime in the orchard?" To this it can be replied that there is no need to apply lime in order to meet the plant food requirements of the fruit. From Table 1 it will be seen that about .4 per cent. of the fruit is ash, the average of four South African analyses (Thorpe's Dictionary of Applied Chemistry) show that about 2 per cent. of the ash is lime, so that on this basis there will be less than 2 lbs. of lime in 500 bushels of fruit. Wickson, in "California Fruits," gives the percentage of lime in the ash as 4.08 per cent., so that, taking this higher figure, the amount of lime in 500 bushels of fruit will be about 4 lbs. This quantity is more than supplied in every cwt. of superphosphate or bonedust applied to the soil. In the superphosphate there would be about 9 lbs. of lime in the form of a soluble monocalcic phosphate, or about three times the quantity in bonedust. As a soil corrective, even the larger amount would have little or no effect, nor would the greater quantity combined with sulphuric acid forming gypsum. For the purpose of improving the tilth of heavy and unkindly soils or for correcting acidity, a dressing of lime may be desirable, but even for these purposes, under our climatic conditions, some doubt was raised by Wenholz\* in his paper before the Australasian Association for the Advancement of Science in 1923. He stated that "lime undoubtedly has the effect of opening up and lightening stiff clay soils, but it is also doubtful here whether its use can be unhesitatingly recommended in all cases. Deep thick-rooting crops and the subsequent decay of these roots in the soil, or the use of organic matter of animal or vegetable matter may be sufficiently effective at less cost. Soils which have been for some time under cultivated crops have lost a considerable amount of their organic matter, and have a greater tendency to run together easily and bake after rain, yet the addition of organic matter by some systematic rotation with pasture, grazing fodder crops with stock or animal or green manuring is known to be a simple and effective expedient in many cases to remedy this physical defect without the costly application of lime."

From Table 8 it will be seen that the unit values for potash in the respective fertilisers are—

Muriate of potash—4s. 10d.

Sulphate of potash—5s. 11d.

Nitrophoska—10s. 5d.

Muriate of potash is relatively the cheapest, and though it also contains common salt, which renders it unsuitable for best results with potatoes, it is quite suitable for orchards. The potash requirements of the trees and crop of 500 bushel cases per acre have been estimated as 75 lbs. This amount is supplied by 150 lbs. muriate or sulphate of potash. As the muriate is the cheaper and is suitable, this form should be used. The potash fertiliser should be applied with the superphosphate in the early autumn in order to stimulate to the fullest extent the growth of the cover crop, whether natural or sown. Though the potash is readily soluble in water, it forms compounds in the soil, and as the experiments at Rothamsted have shown, it does not leach away, but is held in the soil until absorbed by the feeding roots. The common salt, on the other hand, readily leaches out of the soil with the first heavy rains.

\*Some recent views on the Liming of Soils—H. Wenholz, "Agricultural Gazette," New South Wales, January, 1923.

TABLE 8.

*Some Sources of Potash and Cost per Ton—W.A., 1931.*

Sources of Potash.	Potash.	Price per Ton.
		£ s. d.
Farmyard Manure ... ..	·27	...
Wood Ashes ... ..	·6 to 6	...
Sulphate of Potash ... ..	48·6	14 6 6
Muriate of Potash ... ..	50·4	12 1 6
Nitrophoska* ... ..	19·0	23 0 0

\* Contains also N and  $P_2O_5$  with unit values— $P_2O_5$  ... 4s. 3d.

N. ... 12s. 8d.

It will be seen that in Table 8 wood ashes is also given as a source of potash. The percentage is variable, depending upon the timber from which they are obtained. Though the percentage of potash in them is sometimes low, they should not be wasted for they also contain small quantities of phosphoric acid and lime. To save what are available is part of the economy of the farm. The plant food in them is in a very soluble form, and if exposed to rain it will quickly leach into the underlying soil, and leached ashes are of very little value. It is, therefore, necessary to keep the ashes dry whilst they are being conserved prior to their application to the orchard soil.

In Tables 3, 7, and 8 have been given the analyses and costs per ton of some of the various fertilisers on the local market. As already explained the method of calculating the unit value of a single plant food constituent in the compound fertilisers in those tables has been to deduct the value of the other constituent or constituents from the total cost and divide the balance by the number of units of the particular constituent under consideration. The value of the other constituents has been based upon the cheapest rate at which these could be obtained in simple fertilisers. This method was adopted to show the relative costs of single constituents in compound manures, and is satisfactory if the comparison is made with regard to one constituent only. It is, however, unsatisfactory and unfair to evaluate a compound fertiliser from the unit values of its two or three constituents found in this way, for any difference between the unit values of the simple fertilisers and those of the compound fertilisers is exaggerated.

Obviously, a compound or mixed fertiliser is to be valued with regard to all its constituents; then any difference between its cost and the amount for which the same constituents can be purchased in simple fertilisers should be spread proportionately over all the fertilising constituents it contains. Thus, in the case of blood and bone (A), the same amount of nitrogen (5.75 units) can be supplied by sulphate ammonia at 12s. 8d. per unit for £3 12s. 10d., and its phosphoric acid (13 units) by superphosphate at 4s. 3d. per unit for £2 15s. 3d., or both constituents for a total of £6 8s. 1d. The cost of the blood and bone is, however, £11 5s. per ton, or an increase of 76 per cent.; when this increase is spread proportionately over both constituents, it is found that the 5.75 units of nitrogen cost £6 8s., and the 13.00 units of phosphoric acid cost £4 17s., making the total cost per ton £11 5s. Accordingly, the unit cost for nitrogen is 22s. 4d., and for phosphoric acid is 7s. 6d.

Similarly the unit costs of the constituents of the other compound fertilisers have been found and these, with those of the simple fertilisers are set out in Table 9 hereunder:—

TABLE 9.

*Unit Costs of Fertilisers.*

Proportionately distributed in the case of Compound Fertilisers.

	N.			P <sub>2</sub> O <sub>5</sub> .			K <sub>2</sub> O.		
	£	s.	d.	£	s.	d.	£	s.	d.
Blood and Bone (A) .. .. .	1	2	4	0	7	6			
Blood and Bone (B) .. .. .	1	7	9	0	9	4			
Bonedust (A) .. .. .	1	2	11	0	7	8			
Bonedust (B) .. .. .	1	4	2	0	8	1			
Diamonphos .. .. .	1	0	11	0	7	0			
Nitrophoska .. .. .	0	16	6	0	5	6	0	6	3
Sulphate of Ammonia .. .. .	0	12	8						
Nitrate of Soda .. .. .	0	19	7						
Rock Phosphate .. .. .				0	2	6			
Superphosphate .. .. .				0	4	3			
Muriate of Potash .. .. .							0	4	10
Sulphate of Potash .. .. .							0	5	11

The extra cost per unit of the fertilising ingredients in compound or mixed fertilisers is sometimes entirely offset by the convenience and ease of application attached to the use of such a fertiliser.

In Table 10 will be found figures showing the comparative costs of the fertilisers used on a 10-acre orchard in accordance with the scheme which has been outlined when a cover crop is grown, and when 100 and 200 lbs. per acre of superphosphate are used with the cover crop. It will be seen that in both cases when the fertilisers are purchased at the lowest unit rates ruling in the market, the cost is less than one-third of that necessary when they are purchased at the highest rates.

TABLE 10.

*The Apple Tree and Its Food.*

Relative Fertiliser Costs for 10-acre Orchard.

Constituent.	Amount.	Cost.		Amount.	Cost.	
		Lowest Unit Rate.	Highest Unit Rate.		Lowest Unit Rate.	Highest Unit Rate.
N ... ..	200	£ s. d. 5 14 0	£ s. d. 19 4 9	200	£ s. d. 5 14 0	£ s. d. 19 4 9
P <sub>2</sub> O <sub>5</sub> ... ..	220	2 2 6	10 5 0	440	4 5 0	20 10 0
K <sub>2</sub> O ... ..	750	8 2 0	17 9 0	750	8 2 0	17 9 0
	...	£15 18 6	£46 18 9	...	£18 1 0	£57 3 9

Similarly, in Table 11, the relative costs are shown when the whole of the nitrogen requirements are purchased consequent upon no cover crop being ploughed in. From these figures it will be seen that the growing of a cover crop saves the orchardist about £1 2s. per acre on the lowest scale. In both cases the difference between the expenditure at the highest and lowest rates respectively is so great that the need for buying in the cheapest way is emphasised. This is the point it was desired to make. With this object in view the relative costs have been based upon the highest and lowest unit values obtained in connection with single fertiliser constituents. It is believed that in practice such a wide range could never occur because when buying the highest rates have been used from various compound fertilisers, and no orchardist could buy fertilisers on this basis. The difference between the lowest and highest rates at which the different fertilisers can be bought is significant enough, however, to require that the orchardist shall take every care to purchase his fertiliser requirements at the cheapest possible rates.

TABLE 11.

*The Apple Tree and Its Food.*

Comparative Costs, 10-acre Orchard.

Constituent.				Amount Supplied.	Lowest Rate.	Highest Rate.	Amount Supplied.	Lowest Rate.	Highest Rate.
					£ s. d.	£ s. d.		£ s. d.	£ s. d.
N	...	...	...	600	17 2 0	57 14 3	600	17 2 0	57 14 3
P <sub>2</sub> O <sub>5</sub>	...	...	...	220	2 2 6	10 5 0	440	4 5 0	20 10 0
K <sub>2</sub> O	...	...	...	750	8 2 0	17 9 0	750	8 2 0	17 9 0
				...	£27 6 6	£85 8 3	...	£29 9 0	£95 13 3

Summed up, the recommendations in connection with fertiliser practice for apple and pear orchards in Western Australia are:—

1. Grow cover crops containing legumes and deep-rooting plants.
2. Ensure maximum growth of cover crops by manuring early in autumn with—

Superphosphate, 1 to 2 cwt. per acre, and

Muriate of potash, 1 to 1½ cwt. per acre, as required to replace the quantity removed by the fruit crop.

3. Plough the cover crops in, whilst the ground is moist and the plants are succulent, as soon as possible after the middle of August.

4. Provide 20 lbs. nitrogen per acre for trees when the buds are open by applying—

1¼ cwt. nitrate of soda, 2 weeks before flowering, or

1 cwt. sulphate of ammonia, 3 weeks before flowering, or

3.5 tons farm-yard manure, 4 weeks before flowering.

When a good cover crop has not been ploughed in, apply more nitrogenous fertiliser, up to three times the amounts mentioned above, the actual amount depending upon the quantity of cover crop ploughed in.

## STANDARDISING THE APPLE PACK.

A. FLINTOFF, Orchard Supervisor.

Mr. W. M. Carne, of the Commonwealth Council for Scientific and Industrial Research, in reporting on the condition of Australian fruit exported during the season 1931, states, with particular reference to apples—

"I am convinced that many of the defects found in the fruit in London were due to packing and handling. Growers ought to see that the fruit was more carefully packed and graded, thus enabling better resistance to careless handling, which resulted, at present, in bruises."

The following statements were endorsed at a recent important conference of fruitgrowers:—

"There are too many 'styles' in the packing of fruit for commercial purposes, and the sooner growers realise the importance of putting into universal practice a uniform 'pack' the better it will be for the stabilisation of prices, and the satisfaction of growers, dealers, and consumers alike."

The above statements are considered sufficient apology for making some observations and introducing some modifications concerning the "packs" in general use. Undoubtedly, there is a tendency for some growers to drift into certain methods of fruit packing which appear to them to suit the occasion. This may be quite alright if there was need only to satisfy themselves or those of a like mind.

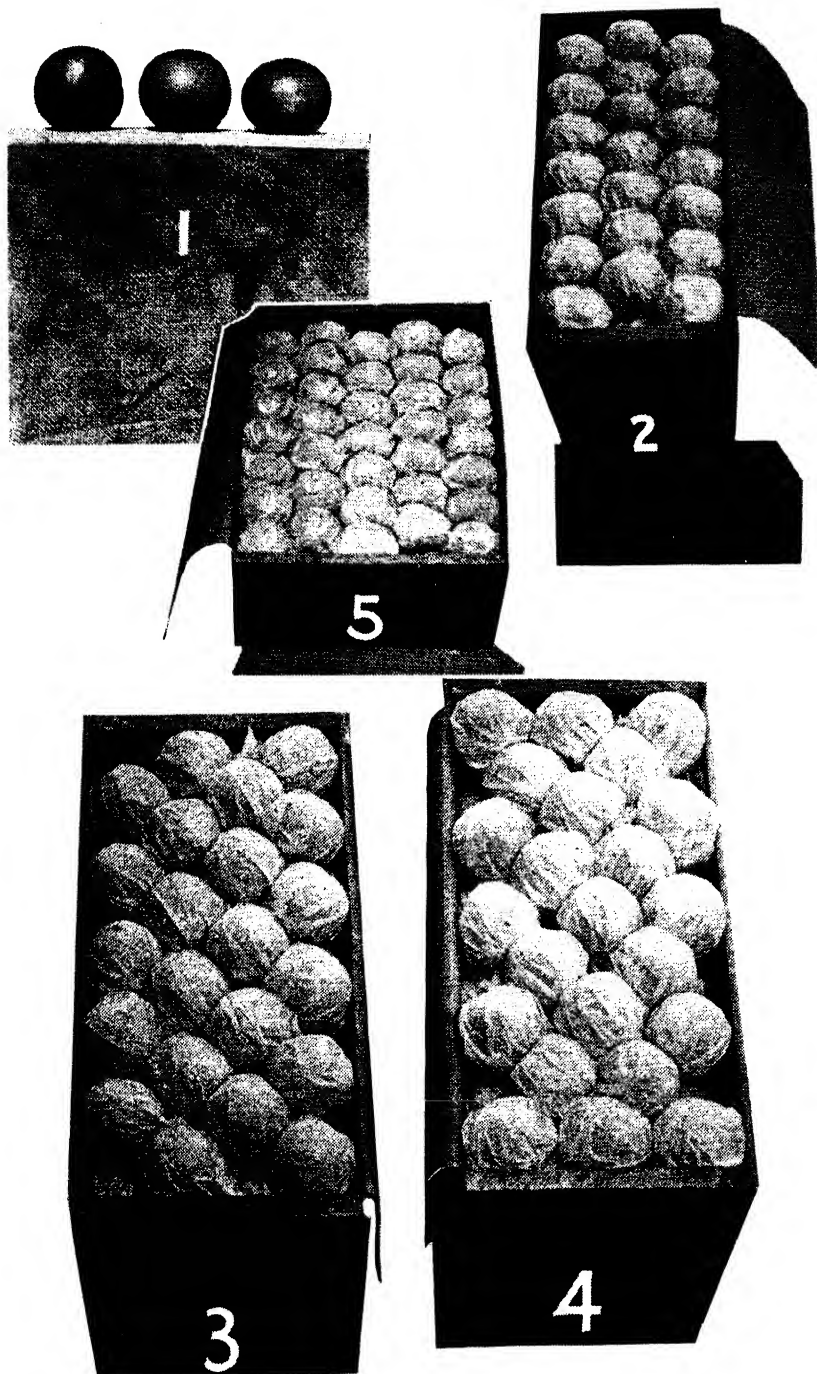
The dealer in fruit has long since realised the prime advantage of a standard "pack" as, by securing uniformity, he knows just what to expect in the way of bruises due to packing. For example, if a dealer finds that a certain arrangement of fruit in a case gives him, after the average usage in transit, a reasonably pressure free, but firmly packed product, he would naturally desire that all supplies be under the same conditions, but if, on receiving, say, a consignment of 2½ inch apples with several cases packed one way, and several another some showing much bruise through over pressure, and some bruised through being too loosely packed, he is not in a position to guarantee the fruit to a customer—thereby confidence may be lost and trade adversely affected. Obviously, the growers, good and bad alike, would ultimately suffer loss. On the other hand, if each grower is satisfied that the "pack" he has chosen invariably meets the demands of the critical dealer and consumer, and that the method is universally acknowledged to be the result of sound research, then he may be sure that the industry will not suffer loss, but has the best chance of stabilisation. It is agreed, however, that other important factors must be observed in connection with a standard "pack." Fruit must be clean, well developed, and carefully picked, but it is not the purpose of this paper to detail any matter except that dealing with packing.

### THE CASE.

As the measurements of the container, or case, have a direct relation to a satisfactory "pack," a few remarks on the subject may not be out of place here. The case used almost exclusively in Western Australia for the export of apples, is known as the Australian dump bushel case, the inside measurements being—length 18 inches, width 8½ inches, depth 14½ inches; cubical contents, 2,223 inches.

As two-thirds of an inch is not shown on the ordinary two-foot rule, it may be of interest to note that five-eighths of an inch is nearest to it, being one twenty-fourth of an inch less than two-thirds inch.





As there is little or no shrinkage of timber "endways," the cubical capacity of the case is controlled by the end boards which have a tendency to shrink side ways. As shrinkage is variable according to the age of timber, it is frequently found that cases are not uniform when required for packing; therefore, the packer should be aware of the difference in widths of cases, to be in a position to pack out with the degree of nicety essential to first-class packing. It is obvious that a case measuring  $8\frac{1}{2}$  inches wide will not allow the fruit to "spread" to the same extent as in one  $8\frac{3}{4}$  inches or wider. It is here suggested that the packer should be provided with a measure to test the width of a case before packing, as he would then know just what "pack" would be most suitable.

#### THE BENCH.

A bench is usually reckoned to be not more than three feet high in front, 3 feet 6 inches at back, and 3 feet 6 inches wide—a board along the front six inches high and one of 1 foot 6 inches at back. A bench 14 feet long should accommodate 25 cases of fruit. From this it may be calculated what bench room would be required to avoid congestion at peak periods in harvest time.

#### THE PACKING TROLLEY.

Growers are familiar with the four-wheeled trolley in general use. It is built to hold the case and paper conveniently for the packer, and no hard and fast rule can be laid down concerning the relative positions of case, paper, and fruit. The packer should be the best judge of this, some preferring a much steeper slope to the case than others. The operator is advised to see that his case is placed before him so that the inside is easily accessible and that the fruit and paper are within easy reach, always realising that with, say, 10,000 apples singly handled in a day, any unnecessary movement with each fruit would, in the aggregate, mean an appreciable loss of time.

#### THE CORRUGATED CARDBOARD.

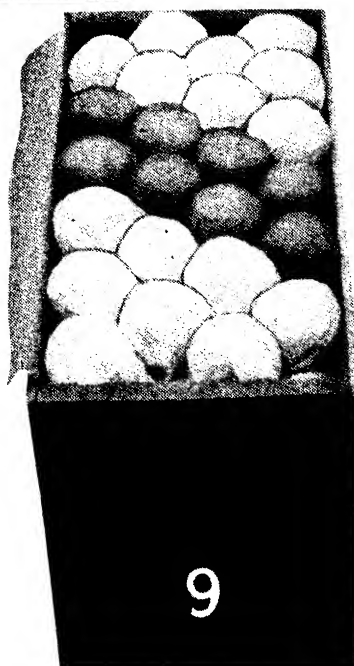
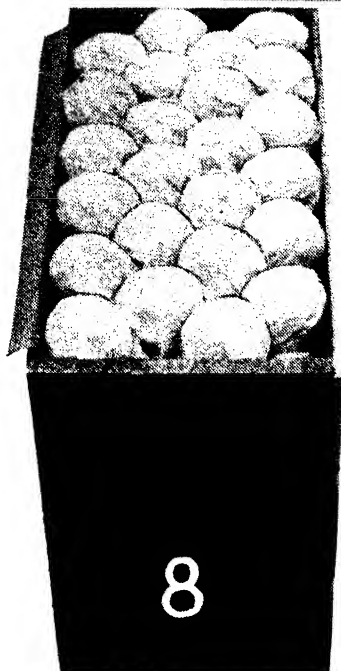
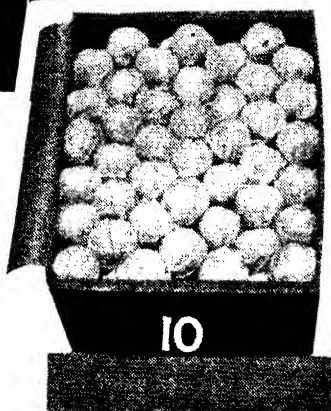
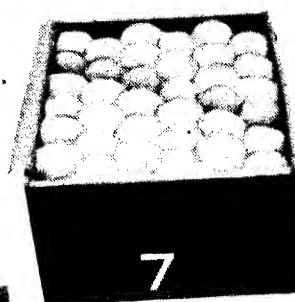
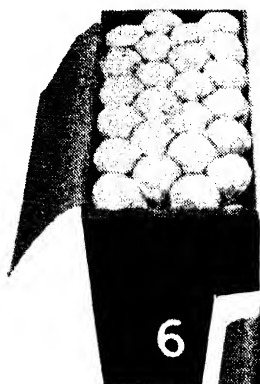
Originally wood-wool was used to form a pad on the bottom of the case, and also on the top of apples at the finish of the "pack." Of later years corrugated cardboards have taken the place of wood-wool. The most recent adaptation of the card-board, where fruit is packed for distant markets, is to line the case entirely. This method has found favour with the trade, as it is claimed that case bruise is thereby minimised. The smooth face of cardboards should be to the fruit.

#### WRAPPING PAPER.

So well known is the practice of wrapping fruit in specially prepared paper that little need be written in this direction; suffice to say that the papers should be of such a size as to completely cover the fruit. The usual proportions observed are—

2	inch apple—	8	inch x	8	inch paper
2 $\frac{1}{4}$	inch apple—	9	inch x	9	inch paper
2 $\frac{1}{2}$	inch apple—	10	inch x	10	inch paper
2 $\frac{3}{4}$	inch apple—	11	inch x	11	inch paper
3	inch apple—	12	inch x	12	inch paper

The glazed surface of paper should be outwards. Oiled wrapping paper is frequently used in the packing of "Granny Smith" apples for late keeping, as its use minimises what is termed "Granny Scald."



### METHOD OF WRAPPING.

Half a dozen packing sheds may be visited, and as many variations in wrapping an apple be seen. This, of course, is of minor importance, provided all undue movement is eliminated and the fruit is properly covered. Generally the expert packer will take up the paper, place it over the apple (first movement): then with a quick movement of both hands and wrist (second movement) efficiently cover the fruit and hold it in the right hand in the correct position for placing in the case. Too careless a wrap is to be avoided, and an over-neat wrap is unnecessary in commercial packing.

Having the foregoing preliminaries satisfactorily arranged, the packer must now consider the method of arrangement of fruit in the box. The first objective is to master the grading, to know in fact, without reference to a measure, what is the diameter of any apple that may be picked up, the diameter or "grade" of an apple being the distance in inches from cheek to cheek across the core. No amount of instruction, without practice, will effect this.

The aim of every packer should be to see that he is in a position to state definitely the arrangement and "count" of any grade of apple. To do this requires a knowledge of the various "packs" and "counts" suited to different "types" of apples.

### TYPES OF APPLES.

If Nature had provided a one shape apple covering all varieties, the arrangement of the fruit in the case would be much simplified, as we could set down a definite "pack" similar for each variety in the same grade. On broad lines, the "types" may be divided into three sections, namely, long, medium, and flat. Illustration 1. These apples are all of one grade, yet quite obviously, of varying lengths measured from calyx to stem.

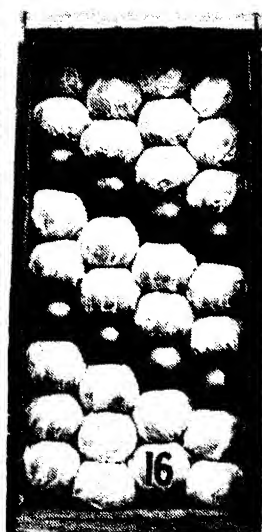
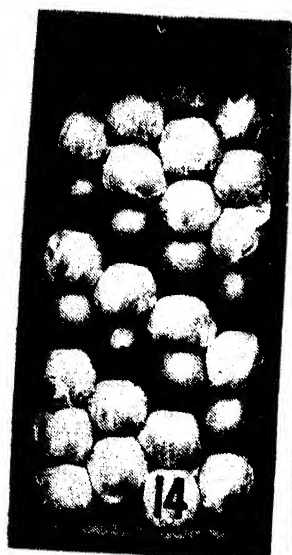
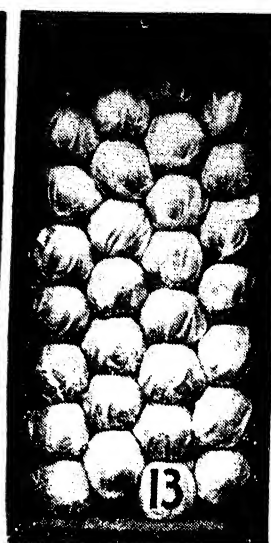
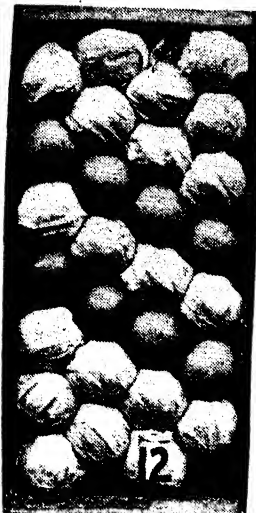
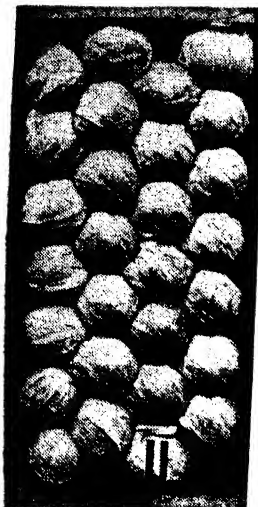
Practice will soon convince the packer that the flat apple will "top up" to a satisfactory height, with less trouble than a long type apple, where similar packs are used for both. Therefore, as before stated, it is essential, to achieve the best results, to know just what pack to use for each type and grade.

### THE "PACK."

In proceeding with the actual arrangement of apples in the box, the packer should realise that the fruit must be so arranged as to effect, when the lid is nailed down, a firm pack that will withstand the usual handling in transit, and when its destination has been reached, will open up reasonably free from pressure or other bruises, and appear before the buying public as an excellent product.

To achieve this objective is, undoubtedly, the aim of all growers and packers, but Nature provides such varied types of apples that it is sometimes difficult to accommodate all the types to a box of one shape and size, and the operation calls for a certain skill and experience.

It has been the task of our pioneers to evolve the original scheme of arranging the fruit and to place before packers, valuable information, arranged in order and readily understandable. Naturally, from time to time, slight modifications of the schedule were found advisable, and such alterations have been adopted where practice has proved their worth. Most, if not all, of Western Australian apple growers are familiar with the excellent "pack" known as the "cheek diagonal," which is a complete reversal of the old "calyx up" pack, the latter being now entirely superseded by the former.



We shall then consider the "cheek diagonal" and "cheek straight" packs as most suited to our use. "Cheek," as the word implies, means the placing of the apple on its cheek or side in the box, the terms "diagonal" or "straight" meaning the "direction" the apple takes in relation to the side or end of the case, "diagonal" showing the calyx looking diagonally towards the side, and "straight," the calyx pointing directly to the end.

There are degrees of firmness in packing, and, although the packer may at times be justifiably proud of showing to the layman how he can upend a full unlidded case without disarrangement of the fruit, there are certain packs which he knows would top up too high if packed with a similar firmness.

Two terms are suggested as being sufficient guide for our purpose, the "firm" and the "free" packs. The former is usually termed "tight" pack, but it may be noted that so-called "tight" packs do not always conform to firmness of every apple, some being removable without any trouble, not having been "firmed" to their fellows.

In the "firm" pack each apple should be placed in the box so as to occupy as little space as possible without crushing. The "free" is a pack that, although not "loose" is not one in which the case may be upended, before lidding, without disastrous results. A "loose" pack is to be condemned, as too much space is left between apples, and, unless very carefully packed, there is a tendency to "rattle" after handling in transit, also the widely spaced fruit does not show to advantage when the case is opened.

Some packing charts show opposite the necessary "counts" advices such as "pack more loosely than usual"; "pack tighter than usual," etc. In the absence of such a chart the following formula is given in order that a packer may, by a simple calculation, determine whether the "pack" has to be "firm" or "free," that is to say, he will know just how to dispose of the amount of apple he will have, in taking up the spaces between fruits and providing necessary top and bottom bulge.

*The Formula.*—Multiply the diameter in inches of the apple by the number of layers in the proposed pack, and subtract the depth of case in inches, for example—

Suppose the beginner takes up a  $2\frac{1}{2}$ -inch apple of the medium type, and proposes to pack it in the orthodox  $3\text{-}2 \times 7$  layer, and is not sure whether to pack "firm" or "free." Apply the formula—

Grade of apple,  $2\frac{1}{2}$  inches; number of layers, 7— $17\frac{1}{2}$  inches

Deduct depth of case— $14\frac{1}{4}$  inches

Remains— $3\frac{1}{4}$  inches

This, of course, means that if the grade is kept "up" there will be a difficulty in disposing of that much apple without having the pack uncomfortably high for lidding, and the obvious thing is to make this a "free" pack with the type and grade of apple mentioned.

Take a further example, same type apple—

Grade of apple,  $2\frac{1}{4}$  inches; number of layers, 7— $15\frac{3}{4}$  inches

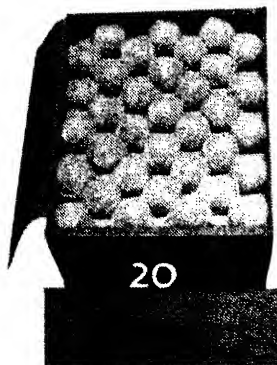
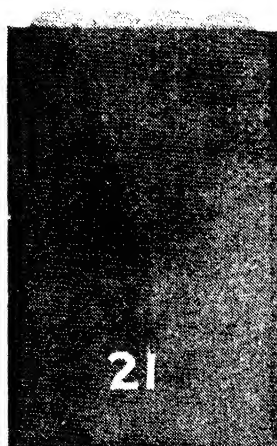
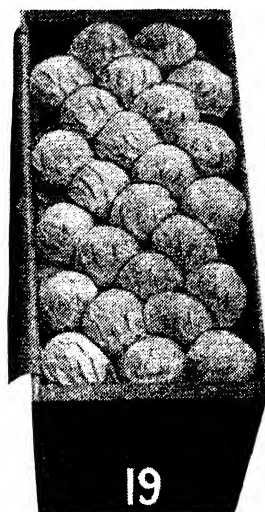
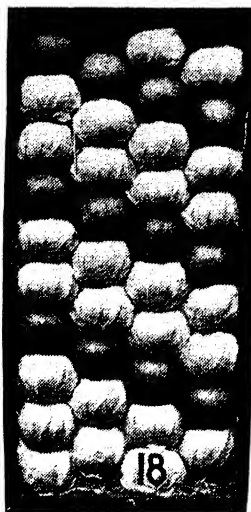
Deduct depth of case— $14\frac{1}{4}$  inches

Remains  $1\frac{1}{2}$  inches.

In this case the packer has but  $1\frac{1}{2}$  inches of apple to provide a bulge and fill "pockets" or spaces between apples.

This would mean that a very firm pack must be used to bring the fruit up to a satisfactory height. It is well to remember that long type apples offer deeper "pockets" for each succeeding layer, and therefore, if there is very little apple to dispose, it is advisable to try out a different pack for certain grades.

The above is just a suggestion for the beginner as, after some practice, the packer will know just what to allow for such type of apple.



### THE COUNT.

The beginner must now consider what "counts" to apply in packing the various grades and types. "Count" means the number of apples placed across the case, also the number from end to end. Reference to illustrations 2, 3, and 4 will make this clear. Illustration 2 shows an apple in each corner representing the first row across. Next, an apple in the centre and touching the two corner apples, represents the second row across. This order is continued until the layer is completed. The "count" lengthwise is first row 7 apples, second row 7 apples, the layer showing that order right across, thus the term  $2-1 \times 7-7$ .

Illustration 3 shows, in the first two rows across 2 and 2, and lengthwise 6 and 5. This is the  $2-2 \times 6-5$  pack.

Illustration 4 shows 3 and 2 apples in the first and second rows across, with 5 and 4 apples in the first and second rows lengthwise, so the pack is  $3-2 \times 5-4$ .

All apples are packed in the bushel dump case in these three styles, the only difference being in the "counts" lengthwise, which vary according to each grade.

### THE $2-1 \times 5$ LAYER PACK.

This pack (illustration 2) is used for apples of  $3\frac{1}{8}$ -inch upwards, the method of placing the apple being "cheek" straight pack, and with the smaller sizes in this section the pack must be very firm. In the illustration the "count" lengthwise is 7-7, and it will be found that this number will decrease as the grade of the apple increases, as 6-6, 6-5, etc.

Illustration 5 shows the  $2-1 \times 7-7$  packed case opened on the side to show number of layers and their arrangement.

### THE $2-2 \times 6$ LAYER PACK.

This pack is most generally used as it covers the grades from  $2\frac{3}{4}$  inches to  $3\frac{1}{4}$  inches. The number of layers in this pack is 6, and the "count" varies from 7-7 lengthwise to 5-4.

Illustrations 6 and 7 show the flat type apple ( $2\frac{3}{4}$ -inch "Dunn's")  $2-2 \times 6-6$  pack, 7 being the case opened on side.

### THE $2-2 \times 7$ LAYER PACK.

Although many packers have definitely adopted this pack for certain varieties, caution should be observed not to overdo it, as, being an easy "pack" the beginner may unconsciously drift into what may be a very undesirable general practice of using the pack with all varieties.

This pack should be used only in dealing with long type apples of  $2\frac{1}{2}$ -inch and  $2\frac{3}{4}$ -inch grades, and medium and flat type apples of neat  $2\frac{1}{4}$ -inch grade. In the case of the long type ("Cleopatra") illustrations 8, 9, and 10 show the same case; 10 being opened on the side. In 9 some papers are removed to show the "direction" of the calyx. It will be noted that the apples on the extreme right have the calyces or eyes pointing to the righthand side of the box, but in all the other apples they have the left side direction. It is important to remember this point, as its observance will assist to get a more uniform diagonal as may easily be seen, and will avoid, by having stem to calyx, breaking the skins through hard stem ends pressing into the apple cheek.

The same rule applies to the  $2\frac{1}{4}$ -inch grade long type apple ("Cleopatra"), illustrations 11 and 12, showing the diagonal "cheek" pack. The uncovered apples in 12 will show the direction as in the  $2\frac{1}{2}$ -inch "Cleopatra."



Dealing with the neat  $2\frac{1}{4}$ -inch apple, it will be found in practice that an apple  $2\frac{5}{16}$ -inch or  $\frac{1}{16}$ -inch over  $2\frac{1}{4}$ -inch will pack  $2-2 \times 7$  layer "cheek" straight pack, without slipping out of place, as the normal box is  $8\frac{3}{4}$  inches inside width, and the four apples across will measure  $9\frac{1}{4}$  inches. It is, therefore, important to remember that the apples chosen for this pack must not be below the  $2\frac{1}{4}$ -inch grade. The packer will find, with this "pack" a cheek on grading of small apples, of which there are a great many in some seasons. Should the apple be under grade it will slip past the apples in the preceding row. The "count" lengthwise will vary according to the type of apple packed. Illustrations 13 and 14 show neat  $2\frac{1}{4}$ -inch apples, long type ("Cleopatras"), packed  $2-2 \times 8-7 \times 7$  layers, the unwrapped rows in 14 showing the direction of calyx.

Illustrations 15 and 16 show the medium type  $2\frac{1}{4}$ -inch grade packed  $2-2 \times 9-9 \times 7$  layers "cheek" straight pack.

Illustrations 17 and 18 show a neat  $2\frac{1}{4}$ -inch flat type apple packed  $2-2 \times 10-9 \times 7$  layers "cheek" straight pack.

#### THE $3-2 \times 7$ LAYER PACK.

This pack is recommended for all flat and medium type apples varying in grades from  $2\frac{1}{4}$  inches to  $2\frac{1}{2}$  inches. In this section will be found a great number of apples sent regularly overseas, and the packer is here again advised not to put these grades into the  $2-2 \times 7$  layer pack, as the  $3-2 \times 7$  layer pack, if properly graded, is much better.

Illustrations 19 and 20 show a medium type ("Rome Beauty") packed  $3-2 \times 5-5 \times 7$  layers: 20, the case open on side.

All of the smaller grades require a firm pack. In all "cheek" diagonal packs, the outside layers, that is, the apples touching the sides of the box, must show the calyx pointing diagonally towards the sides. The inside rows may be "fitted" to suit the pockets made by the underneath layers, but must have a direction diagonal to the side of box.

#### THE $3-2 \times 8$ LAYER PACK.

This pack is to be used for apples of 2-inch and  $2\frac{1}{8}$ -inch grades. Although most growers are anxious to avoid having to pack such small grades, at times owing to adverse weather conditions or very heavy crops, quantities of small apples are produced. The quality of the fruit is mostly good, and it stands up to handling for export excellently. These grades should be packed in the  $3-2 \times 8$  layer style.

The packer will quickly realise that the  $3-2 \times 7$  layer pack is unsuitable, as it will be found that 7 apples of  $2\frac{1}{8}$ -inch grade, placed cheek to cheek, will give only  $14\frac{7}{8}$  inches, allowing approximately  $\frac{3}{4}$  inch for "pockets" and "bulge." Eight layers will give the packer  $23\frac{1}{4}$  inches, which will very nicely bring the fruit to the desired level.

Do not attempt to pack these grades in the  $2-2$  style.

The 2-inch apple, which means that the fruit cannot be put through a 2-inch diameter ring without undue pressure, must be packed "firm" to secure a satisfactory height.

#### THE BULGE.

In addition to the case being filled there is necessity for the apples to be above the top of the case before nailing down, so that the lid, which is flexible, will show a "bulge" of half an inch, at least, in the centre of both top and bottom.

Illustration 21 shows a  $2-2$  pack, medium type ("Dunns")  $2\frac{3}{4}$ -inch grade, and the bulge shown in illustration 22 resulting from that pack. A more pronounced bulge is permissible in the "free" packs as the apples will settle slightly more after lidding.

## THE PRINCIPAL INSECT PESTS OF TOBACCO.

L. J. NEWMAN, F.E.S., Government Entomologist.

In recent years considerable attention has been given in this State to the growing of tobacco.

Many small and experimental plots, also larger commercial areas, have been planted with the view of testing out the possibilities of growing a commercial quality of tobacco, in payable quantities.

The tobacco plant is indigenous to tropical America. Throughout the tobacco growing regions of America this plant is subject to insect enemies. These insects are not numerous, but some of them are difficult to control.

The tobacco is a member of the same family of plants as the potato and tomato, and hence it is likely that the same insects which attack these crops will also turn their attention to the tobacco.

It is not intended here to suggest that in Western Australia we have any more serious tobacco pests to contend with than other tobacco growing countries. It must, however, be recognised by those intending to try the growing of this crop, that it is one that demands close husbandry. It will prove a serious mistake to spread one's energy and labour over too great an area. A few acres well tended will yield better and payable results than larger areas more or less neglected. It is not the quantity of the leaf grown that counts first, but the quality. The aim is to produce a leaf of the required texture, colour, flavour, and burning quality.

Insects are a considerable factor to be considered in the production of good quality leaf.

Damage to the crown bud or by insects boring into the stem may prevent the continued growth of the original stem so essential to the production of first quality leaf. This damage causes the production of lateral growths which do not yield as large or as fine a leaf. Anyone walking through a tobacco field cannot fail to observe the numbers of holes eaten in the leaves by caterpillars, grasshoppers, etc. These holes in a leaf may not affect its use, but certainly reduce the yield and value.

The number of insects injuring the tobacco leaf is large compared to those which injure other parts of the tobacco plant.

A great deal of this injury can be prevented if proper methods of treatment are employed. As before stated, it is not a crop that can be grown for profit unless carefully attended to.

Tobacco is one of those annual crops grown in seedling beds and transplanted to the open field. This is a stage when the plants should be kept under keen observation as they are then very susceptible to damage by cut-worms. The fact that the land to be planted may have been under a crop of clover grass or other weeds, renders it very likely that cut-worms are already in the soil when the planting out is done.

The ideal condition for the control of many of these insects is to place the land to be used for the tobacco crop each year under clean fallow for some time preceding the planting, thus starving out the insects.

It is particularly important that all weeds and rubbish should be destroyed, as these act as harbouring and breeding places for some of the worst insect enemies of tobacco. The grower who permits these weeds to grow in or near his tobacco crop is inviting trouble. The fact that the tobacco is related to other commercially grown crops such as tomatoes, potatoes, cape gooseberries, and other solanaceous plants, is an important factor to keep in mind.

It naturally follows that it would be unwise to attempt to grow a crop of tobacco following on a crop of any of the above-mentioned plants. Rotation of crops is, therefore, positively advised. Failure to practice a system of crop rotation is not only ruinous to soil fertility, but is bad from an entomological standpoint. Therefore, if a field is planted to tobacco this year that was in tobacco last year, it falls heir to a crop of insects which developed in the tobacco the year before. On the other hand, it follows that if a tobacco crop is followed by a very dissimilar crop, many insects dependent upon solanaceous plants for their continuance will be starved out. No one rotation will avoid all insects, some of which are general feeders, but it will go a long way towards control of some of the worst pests.

A further very important point in the preventive measures is to see that all old, useless, and especially overwintering plants are pulled up and destroyed. If allowed to continue suckering, they will act as breeding grounds and thus carry on the pests to the following growing season.

#### *Combative measures.*

To control the various leaf eating and sap sucking insects which attack tobacco, spraying, dusting or poison baiting must become a regular farm practice with tobacco growers.

Against chewing or biting insects it is somewhat of an open question whether the insecticides can be most effectively applied as a wet or dry spray. The dry method is quicker and, I believe, as effective.

Spray mixtures are divided into two classes. First, those that kill by coming in direct contact with the insect and which corrode and eat away its body walls, stuff up its breathing spiracles or poison, by being forced into the body per medium of the spiracles. These are known as "contact insecticides." Such mixtures cannot be applied in advance of the insects, but must be applied directly on to the insects themselves as a wet spray.

The second class of insecticides are known as "stomach poisons." They are used against insects that chew their food and they kill because they are real poisons and are taken internally with the food. These can be applied in advance of attack and in either a wet or dry form.

There is also the method of combining a fungicide and insecticide.

If it is found necessary to use a Bordeaux spray in the seed bed or elsewhere, and leaf-eating insects are also present, arsenate of lead may be added. To every 50 gallons of the Bordeaux add  $1\frac{1}{2}$  lbs. paste arsenate of lead or  $\frac{3}{4}$  lb. powder form. This spray must be used as soon as the poison is added and kept well agitated.

To apply the wet spray, the farmer will need some sort of spray pump; for the dusting a bellows or dust gun must be provided.

In the use of contact sprays, it is very essential to possess a pump having a pressure of at least 60-80 lbs. to the square inch. Many failures follow the use of contact sprays because of the lack of power in the spraying apparatus.

In spraying sap-sucking bugs, it is of little avail to simply wet the insect. The spray must be forced into the breathing spiracles, which can only be accomplished with a suitable pump. It is no good using a weak atomiser which simply forms a dew-like moisture over the insect. The bugs must be thoroughly and forcefully immersed in the spray.

In the use of poison sprays on tobacco, it is advisable not to apply same to plants, after having reached the growing stage of topping; non-poisonous contact sprays should suffice from then onward.

As a matter of fact, it has been determined by the Bureau of Chemistry, America, that there is very little danger of poisoning from tobacco sprayed with

arsenate of lead. The use of the wet spray, however, after the period of topping has been reached, tends to leave a whitish discolouration on the foliage which may be regarded by buyers as detrimental.

In deciding what action to take in dealing with an insect, farmers should be able to recognise the structure of the mouth parts.

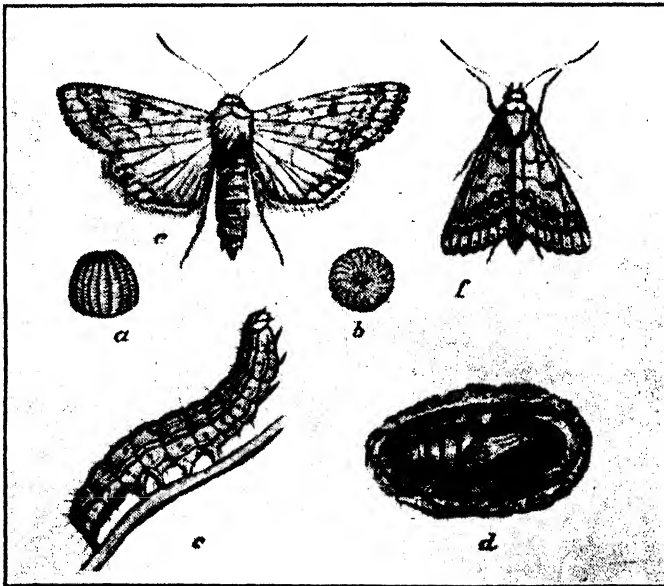
Fundamentally, insects are divided into two classes, biting or chewing and sucking. If the leaves are being eaten or the stems bored, then it should be recognised that a poison spray or dust to the foliage is required.

If, on the other hand, the pest is determined as a sap-sucking one, then a contact spray is required. It is of the first importance for farmers to be able to determine which class of insect he is trying to combat, in order that he may select the proper spray mixture to use against it. This observational knowledge will save much loss of time, material and labour so often expended in the application of the wrong spray.

### THE CLIMBING CUT-WORM OR TOBACCO BUD-WORM (*CHLORODEA OBSOLETA*).

Order—*Lepidoptera*. Family—*Noctuidae*.

This insect is of no new occurrence here, having been reported as a pest for the past 30 years. It is an introduced insect and attacks many kinds of plants, both cultivated and wild. This very general dietary and its rapid reproductive powers render its subjugation or control extremely difficult.



Life stages of the Climbing Cut-worm *Chlorodea obsoleta*.  
U.S. Dept. Agr.

**Description.**—It is a stout-bodied moth measuring about  $\frac{3}{4}$  inch in body length with a wing spread of  $1\frac{1}{2}$  inches. The front pair of wings are usually of a drab brownish colour with brown markings. The hind pair are creamy white with the hind edges shading to black. There are considerable variations in the colours of this moth as there are in the caterpillars, but the above description applies to it generally.

It is a noctuid or night-flying moth, hiding away during the day unless disturbed.

Each female moth is capable of depositing many hundreds of eggs. These are usually placed singly on the plant. The eggs are tiny white objects flattened at both ends and corrugated. They hatch, according to the weather, in from 3-6 days. *The larvae or caterpillars when first hatched* are pale whitish creatures which commence at once to feed upon the foliage or buds. As they grow and moult, they appear in various colours and markings. The caterpillars are full grown in from 18-20 days.

These larvae differ in habits from many other noctuid caterpillars, in that they do not confine their feeding to the foliage but show a decided preference for the buds, flowers and seeds.

*Pupae.*—These are generally found in the soil at a depth of 2 to 3 inches, encased in a flimsy cell, lined with silk. The pupation period is 14 to 16 days (summer) when the moth issues to carry on the work of destruction. The main swarm of caterpillars of this moth appear in September, October, and November, lesser broods appearing at intervals throughout the summer and autumn.

*Measures of Control.*—Keep down all weeds and rubbish. Plant crop, if possible, on clean fallow.

The importance and effect of clean and careful methods of farming are, I fear, usually under-estimated, if indeed they are realised at all. If land has been allowed to become full of weeds and rubbish prior to turning in and planting to tobacco, many eggs, larvae and pupae of this moth will be present in the soil.

Avoid dirty headlands, as it is useless destroying the insect in the crop if we, by other neglect, offer them breeding grounds alongside. Such areas should, if caterpillars are present, be also treated with spray, dust, or bait.

Arsenical sprays or dusts should be relied upon for the control of these caterpillars on the foliage. If attacking the buds, a poisoned bait is applied. The chances are that if the plants are kept well sprayed or dusted at intervals of 10 to 12 days up to the time of topping, the young caterpillars will be destroyed before they can do much damage.

The strength of spray to use is as follows:—Paste arsenate of lead,  $1\frac{1}{2}$  to 2 lbs. to 50 gallons of water.

The use of poison dust sprays is quicker and certainly more popular. This is due to the fact that the use of a wet spray entails the cartage of water which is heavy, and the supply may be somewhat distant from the scene of operations.

The dust should be applied with a suitable bellows or dust gun, if good results are to follow. Whichever method is adopted, the work must be thoroughly done, seeing that all parts of the plant are coated with the poison.

The general dusting formula is 25 lbs. powdered arsenate of lead to 75 lbs. slaked lime, or other inert diluent, every 10 days.

If the caterpillars are numerous and more advanced, use equal parts of the powdered arsenate of lead and lime.

The dust should be applied in the early morning whilst the plants are moist, and there is little wind.

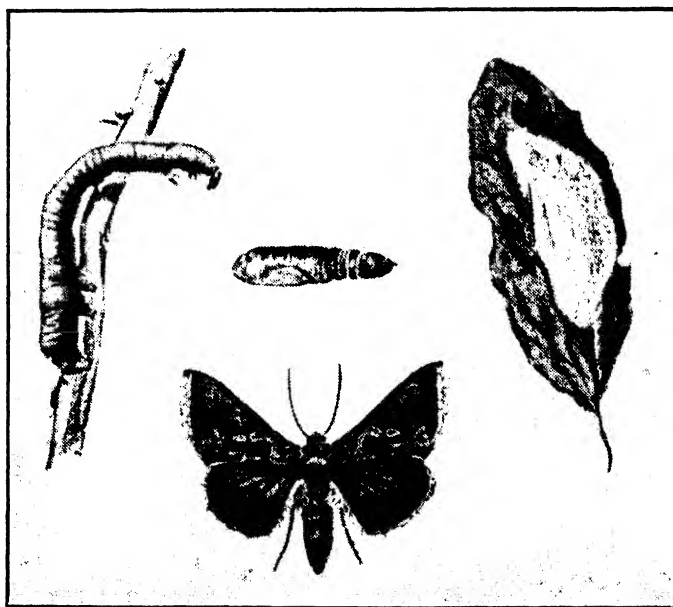
The use of Paris green as a dust is not advised, as there is always a danger of foliage burn when this is used. With practice one can soon become expert at spraying or dusting.

In general, do not use the poison sprays after the topping stage of the tobacco plant has been reached.

If the caterpillars are attacking the buds or growing points, the following bait is advised:—1 lb. powdered arsenate of lead to 25 lbs. pollard. Mix thoroughly together, and apply to the tip of the growing plant. It is necessary to emphasise the need of placing the bait into the centre of the bud. The early applications may be made by means of a finely-perforated tin fastened to a stick. This is shaken over the bud. As the plant increases in size, the bud leaves become more tightly folded, and it is then necessary, to get maximum results from the baiting, to apply the remedy by hand. The bud leaves are carefully parted and the bait dropped in. Care should be taken to see that only a small pinch of the poison mixture is applied to each bud, as excessive quantities may cause bud burn. This baiting should be done at intervals of 7 to 14 days, according to the necessity.

If late foliage treatment after topping is required, it would be wise to use a non-poisonous contact spray such as clensel, katakilla, or pyseet. Clensel, 1 part to 25 parts water; katakilla, 1 carton to 2½ gallons water; pyseet, 1 part to 100 parts water.

For leaf eating caterpillars, such as the Green Potato Looper (*Plusia argentifera*) and other cut-worms, the treatments as advised for the Climbing Cut-worm will prove effective.



Life stages of the Green Looper caterpillar (*Plusia Argentifera*).  
U.S. Dept. Agr.

#### THE COMMON CUT-WORM (*AGROTIS MUNDA*).

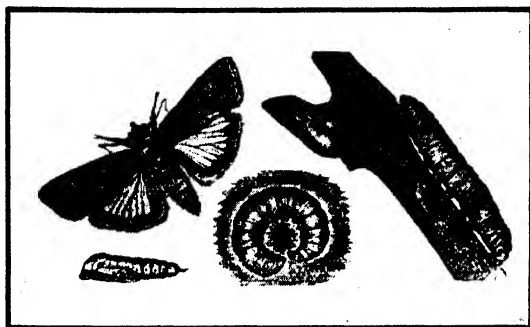
Order—*Lepidoptera*. Family—*Noctuidae*.

The moth is a typical noctuid or night-flying form. Colour—Forewings pale brown, mottled with darker brown and grey. The hind pair very light fawn, with darker shadings towards the outer edges and bordered with a fringe of fine light hairs.

The eggs are small, white objects laid sometimes singly or in clusters on to foliage or on the soil at base of plant attacked. They hatch in 6 to 8 days.

*Larva or caterpillar.*—Thick, fleshy, and tough. Colour, ranging from sandy brown to murky green, and sometimes showing faint lines along the back and sides. Body almost hairless. When touched, these caterpillars curl up and feign death.

*Pupa.*—Pale brown, with small spine at posterior end. Generally found at base of plant, usually, but not always, enclosed in small cocoon covered with particles of soil. There are several generations in a year, the most damaging being October, November, and December.



Common Cut Worm (*Agrotis munda*),  
depicting larvae, pupa, and adult.

The caterpillars come from the ground at night and feed upon the foliage, or cut the young plants off at the ground level. Upon the advent of daylight, they leave the plants and return to the soil at the base, and there remain concealed all day.

If the ground to be planted is suspected of harbouring these cut-worms, it should be thoroughly baited before plants are set out. This treatment to be repeated after planting and whenever cut-worms are found in the crop. Ground baiting should only be applied to the species of cut-worms which return to the soil after feeding.

*Poison Bait.*—Bran 40 lbs., Paris green or arsenate of soda 1 lb, molasses or treacle 3 lbs., water to make to a crumbling mash. In preparing this bait, mix the bran and poison powder together dry. Dissolve the molasses or treacle in sufficient water to make liquid, and wet the bran and poison until of the consistency of a crumbling mash.

Scatter this bait along the rows or around the plant to be protected, seeing that it is not placed immediately against the stem. To be most effective the bait should be spread as late in the evening as possible, so that it will be moist and tempting when the caterpillars come out at night.

Sodium fluoride used at the rate of 1 lb. to 30 lbs. of bran is an effective bait.

In Queensland the following bait is advised:—Bran 12 lbs., pollard 12 lbs., Paris green 1 lb., molasses 1 quart, water 2 gallons. This is somewhat stronger than generally recommended, and might be applied in the case of gross infestation by cut-worms. The quantity of bait used per acre ranges from 10 to 20 lbs.

If caterpillars are invading a crop from outside sources, they can be successfully prevented from so doing by the ploughing of a sharp well cut trench. The furrow should be ploughed or cut with the sharp edge opposed to the caterpillars advancing on the crop. They fall into the trench, and are unable to climb the steep opposing side. They travel along the bottom of the furrow, and if poison bait is placed therein, partake of same to their undoing.

### THE POTATO MOTH OR TOBACCO LEAF MINER AND STEM BORER (*PHTHORIMAEA OPERCULELLA*).

Order—*Lepidoptera*. Family—*Gelechiidae*.

This, if not the most destructive of the moth pests, is certainly one of the most difficult to control.

*Life cycle. The eggs.*—The eggs are tiny white, oval bodies with a pearl-like lustre, about half the size of a small pin's head. They are laid in batches upon the foliage or stems of the plants and hatch in from 4 to 6 days (October to May).



Arrow indicates eggs on leaf.  
(Original.)

*Larva or caterpillar.*—The young caterpillar on hatching is about  $\frac{1}{8}$  inch long, light yellowish, almost transparent body and black head. When full grown is from  $\frac{1}{2}$  inch to  $\frac{5}{8}$  inch long, varying from dirty white to dull green and sometimes to a decided pinkish or flesh colour. The duration of this stage is 17 to 22 days (summer). The young caterpillar on hatching, at once seeks a suitable point of entrance into a leaf or stem. In the case of the leaf, it cuts its way into and



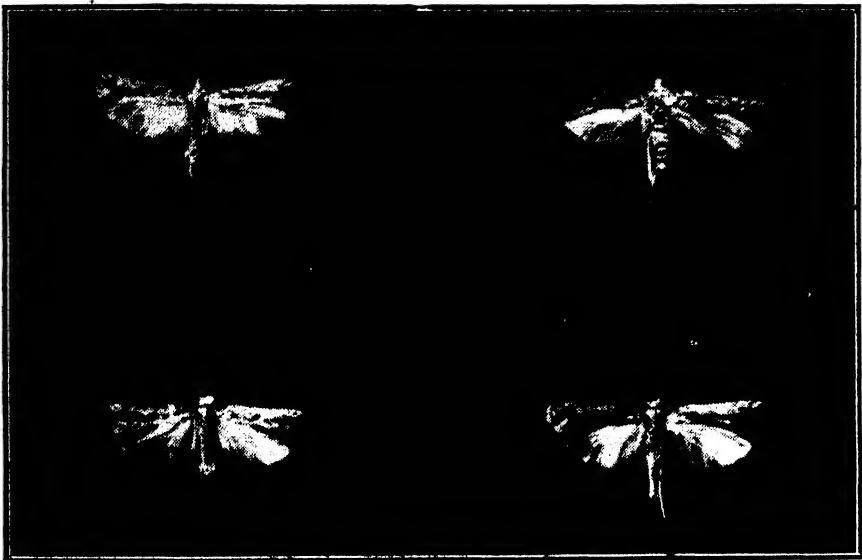
between the epidermal layers or skins. There it feeds, eating out the green or chlorophyll matter. If the stem is attacked, the larva seems to prefer entrance at a node or base of a leaf or side shoot.

*The pupa.*—About three-eighths of an inch long, colour varying from light to dark brown, enveloped in a dirty white silken cocoon, covered with bits of dirt, excrement, or other refuse.

Pupation period 11 to 14 days (summer).

Moth, measures little more than  $\frac{1}{2}$  inch from wing tip to wing tip.

The anterior or front pair of wings are grey and slightly speckled with darker markings, and in certain lights exhibit a distinct metallic sheen. The posterior or hind pair are of a uniform light grey and fringed with remarkably fine hairs.



Potato Moth or Tobacco Leaf Miner and Stem Borer (*Phthorimaea operculella*)  
(original).

The moths are night flying, and live for 11 to 20 days (summer), and lay from 80 to 120 eggs each. There are at least four generations of this insect during the summer months.

The conditions which favour this moth are dry warm weather, the pest reaching its maximum in late autumn.

*Character of injury.*—The larvae mine the leaves and bore into the stems. The presence of the caterpillars in the leaves is revealed by the parchment-like patches due to the caterpillar having eaten out all the green matter.

If the stem is attacked a swelling is often produced, further, the plant wilts from above the point where the larva is working.

Upon cutting open the stem, the small caterpillar is found to have hollowed it out and rendered the plant liable to snap off at the point of injury.

*Preventive measures.*—First and foremost, see that the land to be planted to tobacco has not grown a previous crop of potatoes, tomatoes, or other solanaceous plants. Keep as far away as possible from any such crop. Destroy all old potato



Typical injury caused to leaves by the larvae of the Potato Moth. Note parchment-like patches.

(Original.)

and tomato tops, and cull tubers. Never store potatoes in the vicinity of a tobacco crop. Land to be planted to tobacco must be well worked and freed of all growth, for as long a period as possible before planting.

The plants found to carry and harbour this pest locally are the following:—Potato, tomato, Cape gooseberry, egg plant, nightshade, and apple of sodom.

*Treatment.*—The study of this insect has revealed a weakness that can be taken advantage of. The caterpillar does not pass the whole of its life in the one leaf or tunnel, but has a habit of wandering at different stages of its growth from one part of the plant to another, re-entering at any point it may determine. A knowledge of this migratory habit is valuable, and should be made use of. To this end it is advised to use the wet or dry sprays as applied to the Climbing Cut-worm. If the plants are kept coated with the poison the young caterpillars in eating about here and there before entering or re-entering a leaf or stem, consume sufficient of the poison to cause their death. Once they have gained entrance to the leaf or stem they are safe from all treatments until such time as they decide to come out and seek a fresh entrance.

If plants are observed to be wilting, an examination of same will reveal whether the wilt is due to the presence of the potato moth larva in the stem, or other cause.

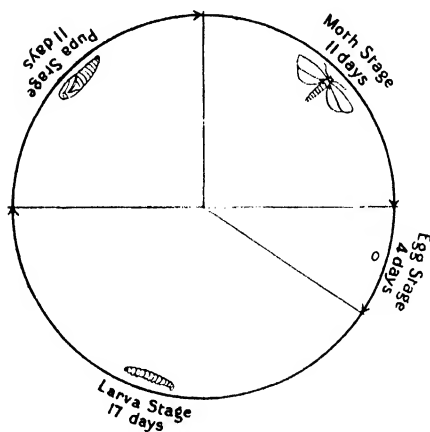


Diagram illustrating life cycle of Potato Moth.

(Original.)

If due to this pest, cut back plant to a sound bud, below the point of attack, and destroy the removed infested portion by burning. This cutting back will cause delay in maturing the leaf, and will induce considerable suckering. Remove all suckers, other than the bud to which the plant has been cut back. This appears to be the only hope once the wilt stage has been reached.

In moving about amongst the plants, any transparent patches observed should be pressed between the fingers, thus destroying the caterpillar within. All old or useless plants to be destroyed, and the land left clean.

Knowing, as we do, that this pest becomes progressively worse, as the dry summer continues, it is a good plan to plant the tobacco crop as early as possible in the spring, thus bringing it to maturity before this leaf miner has become numerous.

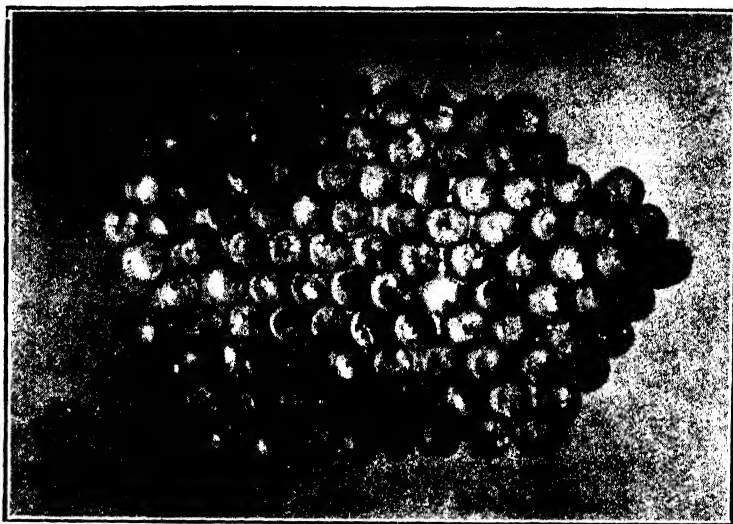
GREEN TOMATO AND BEAN BUG--*NEZARA VIRIDULA* (LINN.).Order--*Hemiptera*. Family--*Pentatomidae*.

This bug first came into prominence in this State in the year 1920. It was described by Linnaeus in Europe, as far back as the year 1758. It is recorded from Europe, Asia, Africa, North America, India, and Australia.

Since 1920, as predicted, it has spread to many parts of the State and has now become one of our major summer insect pests. It has a large number of host plants and fruits upon which it feeds, showing a strong preference for tomatoes and French beans, hence the name we have given to it.

*Life history.*—There are three stages in the life history of this bug, namely, the egg, nymph and imago or adult.

The eggs are white and are deposited in clusters of various numbers up to 100, side by side, usually upon foliage.



Typical egg mass of Bug. Enlarged (original).

The average period of incubation or hatching of the eggs is 8-10 days, according to temperature.

The young emerging bugs push off the cap of the eggs and appear as a dense cluster for several hours. After the first moult they scatter about over the plant.

The nymph or young bug on emergence is dark reddish coloured with a distinct blotch on the centre of the thorax. After the second moult, it appears almost black with varying brownish spots on the outer margin of the thorax and the abdomen covered with rows of white spots. Varying patterns are exhibited after each of the moults. After the fourth moult, the bug comes forth with definite wing pads, antennae 4 jointed, green, shading to brown at tip; thorax pale green with scattered black spots, abdomen in the main pale green with central portion red, surrounded with white markings, the lateral margin of the abdomen and outer margin of thorax pale red. After the fifth and final instar or moult, the full adult winged insect appears as a foliage green-coloured bug. These stages take from 6-9 weeks.

The adult winged imago is oblong oval in form, about  $\frac{3}{4}$  inch long. Dark green above, paler green below. There is a total dissimilarity in colour and markings between the pre-winged and winged stages of this bug. This great variation

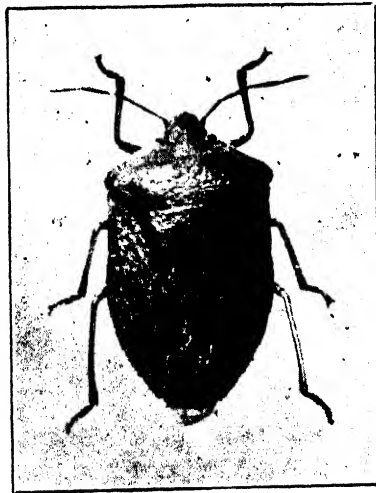


Second nymphal stage after leaving egg.  
Enlarged. (Frogg.)



Fourth or final stage. Note  
wing pads forming.  
Enlarged 3 times. (Original.)

has led to much confusion amongst growers. In fact, many have mistaken the immature bugs for ladybirds. The adult bug lives for several months. There are a number of overlapping generations between October and April. The winter is passed as hibernating adults and nymphs.



Adult or Imago stage.  
Enlarged 3 times.  
(Original.)

*Nature of injury.*—This bug is termed a Haustellate insert, or, in common parlance, a sap sucker. The rostrum or beak is inserted into the sap cells and their contents sucked out. The doing of this not only injures the leaf tissue, rendering it dry and discoloured, but the effect of these myriads of sucking insects upon a plant during hot dry weather causes same to wilt and flag. It is difficult under our dry summer conditions to maintain a broad-leaved plant like the tobacco against the natural loss of moisture, due to transpiration. If, therefore, this natural loss of moisture through the leaves is greatly intensified by the sucking of these insects, it naturally follows that the plant will flag and dry up.

This pest has been observed in the seed beds, but as a general tobacco pest it has yet to prove itself.

Being so partial, as we have proved it to be, to potatoes and tomatoes, it is more than likely that it will turn its attention to the tobacco plant.

*Treatment.*—Knowing that the eggs of this bug are laid in clusters on the foliage of the plant attacked, much good can be accomplished by picking off these egg masses and destroying them.

The habit of the young bugs when first emerged and up to the first moult, is to live and feed gregariously so that they will always be found in clusters near the eggs from which they have hatched. They are more readily destroyed whilst in the pre-winged stage; therefore, every effort should be made to destroy them whilst they are sensitive to contact sprays. Once the adult winged stage is reached, it is a most difficult pest to destroy.

The bug is purely a sap sucker. It is, therefore, useless to apply poison dusts and sprays as for caterpillars. The only way a plant bug can be destroyed is by fumigation or contact spray. In general, fumigation is out of the question, owing to the cost of materials.

In the use of contact sprays, it is very important to see that the pump used has sufficient power behind it to ensure that the spray is forced into the breathing spiracles. As previously mentioned, the mere wetting of the bugs with the spraying material is not sufficient.

To meet the difficulty occasioned by the presence of this pest, the grower must provide a suitable spraying outfit. Whatever style of pump is used, it should be fitted with 3 or 4 feet of extension pipe, a curved elbow, and a good nozzle.

The following sprays can be used with good effect:—

Phenyle 1 quart, washing soda 3 lbs., soap 2 lbs., water 40 gallons. Shred the soap and dissolve by boiling in 2 gallons water, add the other ingredients, and break down to the required strength by the addition of the balance of water.

Another useful formula is the following:—Soft soap 4 lbs., turpentine 1½ pints, water 20 gallons. Dissolve the soap in 4 gallons of boiling water, remove from fire and allow to cool off, but not get cold. Add the turps, stirring thoroughly and make up to 20 gallons with water.

Carbolic Lifebuoy Soap spray.—1 cake of this soap to the gallon of water. Shred the soap, and dissolve by boiling. Apply warm.

Concentrated densenel, a proprietary spray, used at a strength of 1 part to 60 parts water is effective, especially against the pre-winged stages.

Pyseet, a ready to use pyrethrum spray, at 1 part to 100 parts water is also good.

Katakilla proprietary spray, at a strength of 1 carton or packet to 2½ gallons of water, will destroy the bugs.

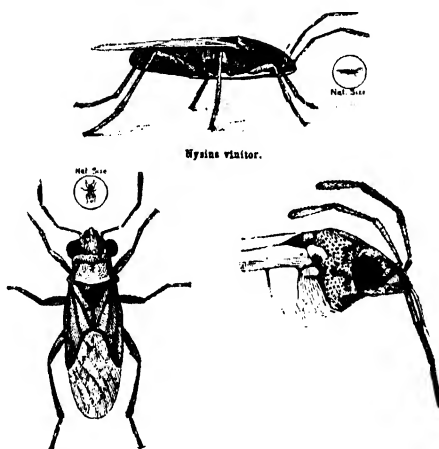
All these sprays are non-poisonous. Never apply to foliage during very hot weather, or when rain is about to fall.

Do not use the phenyle or carbolic sprays just before picking, as they may impart an objectionable odour and flavour.

RUTHERGLEN BUG (*NYSIUS VINITOR*).Order—*Hemiptera*. Family—*Lygaeidae*.

This bug, like the Green Tomato Bug, is a sap-sucking insect. The adult is small, and of a light greyish brown colour, about  $\frac{1}{6}$  inch in body length, and slightly under  $\frac{1}{4}$  inch from wing tip to wing tip. The wings are silvery grey, semi-transparent, and traversed by a few dark lines.

The eggs are elongate, slightly curved, white, and laid in clusters upon certain weeds or cultivated plants. They hatch in from 6 to 10 days. The nymphal or pre-winged stages of which there five, occupy about 24 days. The bugs are then full grown, having taken 34 days from egg to adult.



Rutherglen Bug (*Nysius vinitor*).  
N.S.W. "Journal of Agriculture."

During the pre-winged stages the bugs are somewhat scattered. When adult they mass together. The females cannot lay until 10 days after reaching the adult stage. From 300 to 400 eggs may be laid. The damage is caused by the concentrated hordes which attack a crop.

*Preventive measures.*—Complete farm sanitation must be practised, which means the keeping down of all weeds and rubbish. All headlands and fence alignments, so often used as rubbish dumps, must be kept free of all rank growth and rubbish.

*Treatment.*—Keep a sharp lookout for the first signs of the pest, and when found take immediate action.

Generally speaking, the same sprays as advised against the Green Tomato Bug will suffice.

Black Leaf 40, 1 pint, soap 3 lbs., water 70 gallons is effective.

A proprietary spray, known as Benzole Emulsion, used at the rate of 1 lb. to 5 gallons water, gives good results.

A home-made preparation: Sunlight soap 8 ozs., turpentine 8 tablespoonfuls, water 4 gallons. Shred the soap and dissolve by boiling in 2 gallons of water. Remove from fire and allow to cool off, but not thicken, and stir in the turpentine. Make up to four gallons by the addition of a further 2 gallons of hot water. Apply hot.

Another good home-made spray is tobacco stems or dust 2 lbs., soap  $\frac{1}{2}$  lb. Place the tobacco and soap in 1 gallon of water and boil lightly for 1 hour, strain off, and make up to 6 gallons with cold water.

Dusting with Cyanogas Dust A 1 part, sulphur 2 parts, gives excellent results. This is, however, somewhat expensive.

Apply with dust gun as soon as foliage is dry, and when little or no wind is blowing. Keep to windward when using and inhale as little as possible, as it is a deadly poison. After giving off the hydrocyanic gas, the residual dust left on the foliage is quite harmless. Like all other dusts, it must be thoroughly applied. Do not apply to moist foliage.

*Trapping method.*—Make shelters or congregating places for the bugs by piling heaps of rubbish here and there between the rows of plants. The bugs will congregate under these heaps, and may there be destroyed by spraying or the application of boiling water. These bugs must be dealt with in the heaps before the sun has warmed them up.

Tarred screens or canvas, spread under the plants and the plants shaken, will cause the bugs to fall on to the screen where they will be held captive.

If outside areas are infested, a burning over will destroy myriads of the bugs.

Smudge or smoke fires are sometimes used against this bug as a means of driving a winged swarm out of a crop.

## THE VEGETABLE WEEVIL (*LISTRODERES PRAEMORSA*).

Order—*Coleoptera*. Family—*Curculionidae*.

This pest has been found both in the seed beds and amongst the field crops. Up to date it has not proved to be a serious trouble. Knowing how widespread it is and what numerous host plants it has, including potatoes and tomatoes, it possesses dangerous possibilities as a tobacco pest.

This destructive beetle belongs to a small group of weevils which damage plants feeding upon same in both its larval and adult stages. It is nocturnal, or night feeding.

The grubs are legless and live in the soil, coming to the surface to feed at night. This stage occupies from 12 to 14 weeks.

When full grown the grub burrows into the soil from  $1\frac{1}{2}$  to 2 inches, forms an earthen cell, and therein pupates. This period under cage incubation lasted 17 to 21 days.

The imago, or adult—this is a typical weevil with short stout beak, bearing the usual elbowed antennae, clubbed at the tip. The general colour is light brown with the sides of the wing covers light fawn. The weevil has a corrugated appearance when looked at with a lens. Two oblique patches, consisting of light grey scales, forming somewhat of an inconspicuous V-shaped mark, are to be seen at the posterior ends of the elytra. Just below these marks are a pair of processes giving a pointed or spined appearance. The legs and undersides of the body are dark red. When handled it feigns death. Flight wings are present under the elytre, but so far we have not witnessed any flight.

*Nature of damage.*—The grubs feed upon the undersides of the leaves, the adults feed generally upon the foliage which they cut into holes. They are mandibulate or biting insects.

*Prevention.*—Keep land free of clovers, cape weed, and other weeds which readily harbour this weevil. Fallow is a certain method of ridding the land of this pest.



*Treatment.*—Poison bait. The same as is used for cut-worms. This bait is distributed around the plants to be protected, as late in the day as possible.

Spraying or dusting with arsenate of lead was also found to be effective. Paste arsenate of lead 1 lb., water 16 gallons, or powder arsenate of lead  $\frac{1}{2}$  lb.



Vegetable Weevil.  
*Listroderes obliqua* (Gyll).  
Dorsal or Back View.  
( $\times 6$  original.)

If using dust poison, apply equal parts powdered arsenate of lead and slaked lime.

Should this weevil appear in the seed beds, do not apply the Paris green bait. Spray with paste arsenate of lead, using 1 lb. to 16 gallons water, or dust with the following:—Pollard 25 lbs., powdered arsenate of lead 1 lb.

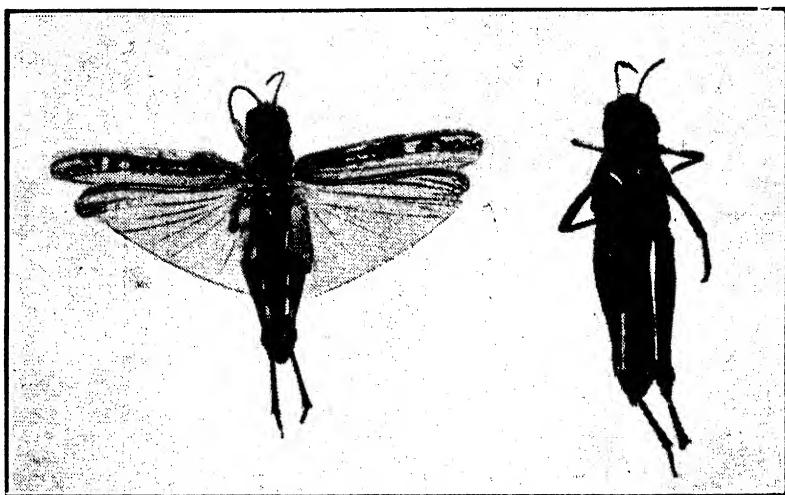
### LOCUSTS OR GRASS-HOPPERS.

The common locust or grass-hopper is the species known as *Chortoicetes terminifera*. Order—*Orthoptera*. Family—*Acridiidae*.

These insects breed in the surrounding undisturbed lands. The eggs are laid in the soil. These hatch out in August-September. The prewinged stage covers a period of 6-8 weeks. Owing to irregular laying, the issue of hoppers occurs in what might be termed relays.

*The adult or winged form.*—The colour of the fore or front wings is light brown, mottled and splashed with darker brown and clouded at the tips. Hind wings transparent and clouded at the apex.

The general colour of the insect is amber brown, legs marked with spots or bands of chocolate brown. The body length from head to tip of folded wings about  $1\frac{1}{4}$  inches. They are provided with strong wings and are capable of considerable flight.



Adult Plague Locust (*Chortoicetes terminifera*).

(Original.)

*Control.*—This offers many difficulties. The chief of these are the breeding grounds, roadsides, waste unoccupied, poor bare lands, etc. Here the eggs are deposited and hatch out unmolested, later migrating as the natural herbage dries up, into the surrounding crops. Every effort should be made to cope with the pest whilst in the hopper stage.

Burning over useless infested areas will destroy great numbers of the hoppers.

As non-poisonous sprays for the destruction of hoppers, the following sprays were found effective:—Burford's household Carbolic soap  $2\frac{1}{2}$  ozs. to the gallon of water and Sunlight soap 2 ozs. to the gallon. Apply hot. Most effective in the early morning when the hoppers are sluggish. Katakilla 1 carton to 2 gallons water may be used as a contact spray.

Spraying with arsenate of soda 1 lb., molasses 4 lbs., water 12 gallons, was very fatal to the prewinged stages. This spray can only be applied to the weeds and grass or directly on to the bodies of the hoppers. It must on no account be brought into contact with the growing crop, as it will burn the foliage.

**Poison baiting.**—Arsenate of soda or Paris green 1 lb., bran 30 lbs., molasses or treacle 4 lbs. Mix to a crumbling mash and distribute amongst the grasshoppers in the early morning. Having fasted all night, they readily take the bait which kills them. All baiting or spraying for the grasshoppers should be done in the early morning.



Typical ring of males as seen around egg-laying female.

(Original.)

If preferred, sodium fluoride may be substituted as the poison medium in the bait, using 1 lb. to the 30 lbs. of bran.

#### . THE RED-LEGGED EARTH MITE (*HALOTYDEUS DESTRUCTOR*).

Order—*Acarina*.

Mites are not true insects, but as some species cause damage to plants and animals, they are included in Agricultural Entomology.

The above mite now constitutes one of our most serious winter plant pests. Its damage to tobacco is confined, in the main, to the young seedling stage and for a period after planting out. Once the plant begins to make rapid growth and get away from the soil surface, the mite does not cause serious trouble.

*Life history.*—The mite makes its appearance about the first week in May, following the advent of the winter rains. These young mites have hatched from aestivating or over-summering eggs. These eggs were laid in the late spring as the pastures dried up. They resist the dryness and heat of the summer, hatching out in the autumn.

The eggs are oval smooth bodies, reddish orange colour, attached to objects, under clods of earth, or as in the winter laid on to the foliage of the plant. The winter eggs hatch in from 8-10 days.



Fig. 1.

(Original.)

Eggs of mite on leaf surface, greatly magnified.

*The larval stage*—The newly hatched mites are six-legged. Within seven days they go through a moult, casting their skin and appearing with eight legs.

*The nymphal stage.*—During this period several moults take place, until the adult stage is reached. This period occupies 25-30 days.

*Imago or adult.*—Size  $\frac{1}{25}$ th inch. Colour—mouth parts and legs bright red, body dense velvety blue-black. The mite is soft-bodied and very delicate. The mouth parts are formed for rasping rather than for piercing. The life of the adult is 30-35 days.



Fig. 2. (Original.)  
Adult female, dorsal view,  
magnified by 20.

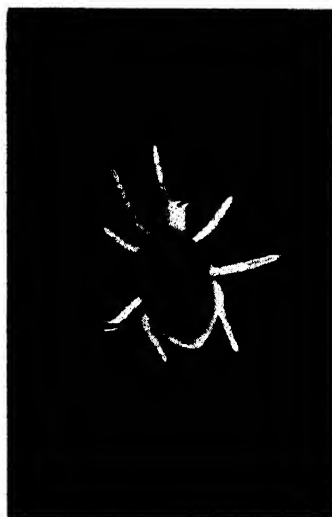


Fig. 4. (Original.)  
Adult male, magnified by 20.

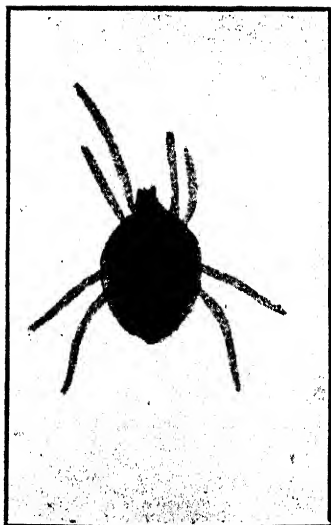


Fig. 5. (Original.)  
Adult female, ventral view,  
showing eggs in body, magni-  
fied by 20.

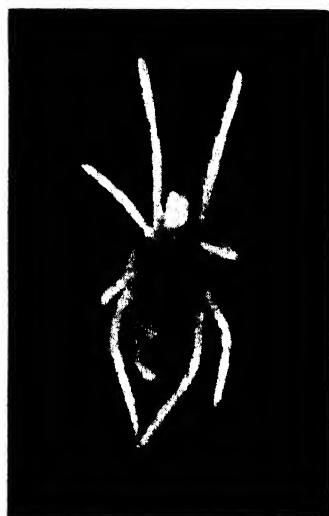


Fig. 3. (Original.)  
Adult female, ventral view,  
magnified by 20.

This pest attacks many kinds of plants, showing a preference for clovers and other legumes. Cape weed is also a common host plant. Potatoes are seriously attacked and tobacco in the young growing stages.

*Treatment.*—Keep down all weeds and rubbish. Place land to be used as seed beds under clean fallow. Plough land to be planted deeply. Dip all seedling plants in a solution of black leaf 40 and soap before planting out. 1 teaspoonful black leaf 40, 1 oz. soap, 1 gallon water.

For a general spray for seed beds and young plants, black leaf 40 1 lb., soap 3 lbs., water 70 gallons, is effective.



Fig. (Original).  
Leaf of plant showing typical injury caused by mite.

*Kerosene emulsion.*—Kerosene 2 gallons, soap 1 lb., naphthaline  $\frac{1}{2}$  oz. Dissolve the naphthaline in the kerosene. Shred and boil the soap in 1 gallon of water. When boiling, remove to another vessel, add kero-naphthaline and churn violently for several minutes until an emulsion is formed. This, upon cooling, will form a stock solution. When using, add 1 part of stock to 8 parts water.

Phenyle 1 part to 80 parts of water is a cheap and effective spray. This must not, because of its cheapness, be applied per medium of a watering can, a spray pump being necessary and only sufficient spray used, to contact with the mites. To saturate the seed bed with the phenyle solution is injurious to the young plants.

Dusting the seed beds with flaked naphthaline is a good repellent. This substance is insoluble in water and will not injure the plants.

Clensel 1 part to 60 parts water will kill the mite.

Katakilla will do likewise, using 1 packet to 3 gallons water.

Pysect, 1 part to 100 parts water is good.

Dusting with powder containing not more than a 3 per cent carbolic content is effective. Formula—1 lb. of 15 per cent. carbolic powder, mixed with 4 lbs. lime, tobacco dust or other inert carrier.

A good dusting powder is made as follows:—Half a kerosene tin of tobacco dust, half a kerosene tin of lime,  $\frac{1}{2}$  pint kerosene. Add the kerosene overnight and allow to permeate the mixture.

A band of creosote placed around a seed bed will prevent the mites from migrating into the young seedlings from outside sources.

### THRIPS.

Several species of these insects are found upon tobacco foliage. They feed by rasping and sucking, for which purpose the mouth parts are formed.

Thrips respond readily to treatment when they can be reached by a spray.

Watch for any outbreak of this pest and spray with the black leaf 40 and soap mixture or any of the other contact sprays mentioned in this article.

## SHEEP FEEDING EXPERIMENT.

### MURESK AGRICULTURAL COLLEGE.

J. H. RICHES, B.Sc.Ag. (Hons.).

### INTRODUCTION.

As reported elsewhere, (1) in the summer and autumn of 1930 an experiment in the feeding of sheep for maintenance was carried out at the Muresk Agricultural College. The results obtained in this experiment seemed to be of sufficient interest to justify the carrying out of further investigations along the same lines; accordingly, in 1931, a further experiment of similar type was undertaken.

### METHOD.

The site of the experimental paddocks was the same as in the previous experiment, and again lots of 20 sheep each were used, merino wethers being chosen for the experiment. The flock available to choose from consisted of one hundred and forty North-West and Murehison bred sheep, and were a fairly even line. They ranged in age from six-tooth upwards, but all had sound mouths, and were in fair condition. Although station bred, they had been depastured in the Avon Valley for about 12 months prior to the commencement of the experiment, and were apparently thoroughly acclimatised, and quite quiet.

As in the previous experiment, each sheep was numbered and weighed individually once a week (except when prevented by rain), and a careful record kept of all weights.

The experiment commenced on 25th February, and was continued for a period of just over 18 weeks until the 4th July—when green feed was becoming plentiful once more.

### RATIONS.

Wheaten straw was again supplied in liberal quantities in an attempt to stimulate stubble conditions, and again farm grown feeds were used. As, in 1930,

wheaten chaff and silage, when fed alone, were found to be quite unsatisfactory, they were excluded from this experiment. Instead, two other rations were tried out, viz., oaten hay, cut fairly green, and wheat grain mixed with silage.

The rations, which were intended to be approximately equal in starch equivalent, are given in Table I.

TABLE I.  
*Ration Fed per Head.*

Lot No.	25-2-31 to 13-4-31.				14-4-31 to 4-7-31.			
	Oats.	Wheat.	Hay.	Silage.	Oats.	Wheat.	Hay.	Silage.
1 ...	...	...	1½lbs.	...	...	...	1½lbs.	...
2 ...	½lb.	...	...	...	¾lb.	...	...	...
3 ...	¾lb.	...	...	1½lbs.	¾lb.	...	...	2 ⅞lbs.
4 ...	¾lb.	...	...	¾lb.	½lb.	...	...	⅞lb.
5 ...	...	¾lb.	...	1½lbs.	...	¾lb.	...	1½lbs.

It will be noted that the ration was changed on 14th April, 1931. This alteration was made owing to the fact that all lots were losing weight steadily and fairly rapidly. All rations were, therefore, increased approximately by half as much, again.

The oats, wheat, hay and silage were all produced on the college farm. The oats were feed oats, rather thin, and containing a somewhat high percentage of weed seeds. The wheat was of fair average quality. The oaten hay was from a crop of Algerian cut shortly after flowering in 1930, and was a fair sample. The silage was made in 1930 from a crop of oats and peas, and was a good sample of acid brown silage, light brown in colour.

In Table II, are given the analyses of the various feeds, as determined by the Government Analyst from representative samples.

TABLE II.  
*Analyses of Feeds.*

	Oats.	Wheat.	Hay.	Silage.
Moisture ... ..	9.05	9.71	9.38	68.90
Ash ... ..	3.80	1.58	5.13	1.69
Crude Protein ... ..	5.91	7.74	4.42	2.88
Ether Extract ... ..	4.98	1.24	1.96	0.86
Fibre ... ..	14.46	2.75	25.97	9.12
N. Free Extractives ... ..	61.80	76.98	53.14	16.55
	100.00	100.00	100.00	100.00

None of the rations were rejected by the sheep, except in the case of Lot 1, in which the hay was fed long and some of the thicker stems were not eaten; it was, however, impossible to ascertain the exact quantities.

*Results.*—The average weights of each lot at the beginning, and at each successive weighing period, are given in Table III.



TABLE III.  
*Mean Weight of Sheep in each Lot at successive Weighings.*

Lot No.	25-2-31.	2-3-31.	9-3-31.	16-3-31.	23-3-31.	30-3-31.	14-4-31.	20-4-31.	27-4-31.
1 ... ..	93.68	90.98	90.73	89.73	90.03	87.33	85.23	86.10	85.28
2 ... ..	94.23	92.80	92.38	91.28	91.18	89.58	85.25	86.35	84.58
3 ... ..	94.00	96.43	96.53	93.78	93.75	91.73	88.40	89.83	89.10
4 ... ..	94.48	96.70	95.68	93.35	93.23	92.95	87.95	89.15	87.48
5 ... ..	95.18	94.03	91.13	91.95	90.90	90.85	86.68	88.08	87.83

Lot No.	6-5-31.	18-5-31.	25-5-31.	1-6-31.	8-6-31.	10-6-31.	15-6-31.	22-6-31.	4-7-31.
1 ... ..	84.90	82.80	81.15	82.33	80.78	...	80.33	80.90	79.58
2 ... ..	87.30	84.30	84.95	84.13	83.20	...	82.73	82.80	82.00
3 ... ..	89.10	88.65	88.90	89.43	89.53	...	89.20	88.38	88.38
4 ... ..	88.88	86.78	88.45	86.50	...	87.20	86.83	87.03	86.30
5 ... ..	88.13	87.13	88.18	88.90	...	88.45	88.90	89.03	88.63

In Table IV. are shown the mean percentage variations of each lot, at successive weighings, from the initial mean weights.

TABLE IV.  
*Variations from Initial Mean Weights.*

Lot No.	2-3-31.	9-3-31.	16-3-31.	23-3-31.	30-3-31.	14-4-31.	20-4-31.	27-4-31.	6-5-31.
1 ... ..	-2.70	-2.95	-3.95	-3.65	-6.35	-8.45	-7.58	-8.40	-8.78
2 ... ..	-1.43	-1.85	-2.95	-3.05	-4.65	-8.98	-7.88	-9.65	0.93
3 ... ..	+2.43	+2.53	-0.22	-0.25	2.27	5.60	4.17	4.90	4.90
4 ... ..	+2.22	+1.20	1.13	-1.25	-1.53	6.53	5.33	-7.00	-5.60
5 ... ..	-1.15	-4.05	-3.23	-4.28	-1.33	-8.50	-7.10	-7.35	-7.05

Lot No.	18-5-31.	25-5-31.	1-6-31.	8-6-31.	10-6-31.	15-6-31.	22-6-31.	4-7-31.
1 ... ..	-10.88	-12.53	-11.35	-12.90	...	-13.35	-12.78	14.10
2 ... ..	-9.93	-9.28	-10.10	-11.03	...	-11.50	-11.43	-12.23
3 ... ..	-5.35	-5.10	-4.57	-4.47	...	-4.80	-5.62	-5.62
4 ... ..	-7.70	6.03	-7.08	...	7.28	7.65	-6.55	-8.18
5 ... ..	-8.05	7.00	-6.28	...	-6.73	-6.28	6.15	-6.55

TABLE V.  
*Percentage Variation from Initial Mean Weights.*

Lot No.	2-3-31.	9-3-31.	16-3-31.	23-3-31.	30-3-31.	14-4-31.	20-4-31.	27-4-31.	6-5-31.
1 ... ..	-2.88	-3.15	-4.22	-3.90	-6.78	-9.02	-8.09	-8.97	-9.38
2 ... ..	-1.52	-1.97	-3.14	-3.25	-4.95	-9.54	-8.37	-10.25	-7.36
3 ... ..	+2.59	+2.70	-0.23	-0.27	-2.40	-5.94	-4.42	-5.20	-5.20
4 ... ..	+2.35	+1.27	-1.19	-1.32	-1.62	-6.91	-5.64	-7.41	-5.93
5 ... ..	-1.21	-4.26	-3.40	-4.50	-4.55	-8.93	-7.46	-7.72	-7.40

Lot No.	8-5-31.	25-5-31.	1-6-31.	8-6-31.	10-6-31.	15-6-31.	22-6-31.	4-7-31.
1 ... ..	-11.62	-13.38	-12.12	-13.77	...	-14.25	-13.64	-15.05
2 ... ..	-10.54	-9.85	-10.72	-11.71	...	-12.21	-12.14	-12.99
3 ... ..	-5.68	-5.41	-4.85	-4.74	...	-5.09	-5.96	-5.97
4 ... ..	-8.15	-6.38	-8.44	...	-7.70	-8.09	-6.83	-8.65
5 ... ..	-8.45	-7.35	-6.59	...	-7.06	-6.50	-6.45	-6.88

*Statistical Analysis.*—In order to form an estimate of the significance of the differences between the various rations in their effect on live weight, it is necessary to treat the final results by statistical methods. Such an analysis shows that for odds of 20 to 1 against the difference being due to chance the significance difference is 4.16.

Reference to Table V. shows that the differences between Lot 1 and Lots 3, 4, and 5, and between Lot 2 and Lots 3 and 5 are all considerably greater than this, and are therefore definitely significant. The difference between Lots 2 and 4, while slightly less than 4.16, shows odds of over 10 to 1 against chance, so is probably also significant. The other differences may all be due to chance.

TABLE V.  
*Differences between Means.*

Lot Nos.				Difference.	Lot Nos.				Difference.
1 and 2	...	...	...	2.145	2 and 4	...	...	...	4.075
1 and 3	...	...	...	9.10	2 and 5	...	...	...	6.285
1 and 4	...	...	...	6.22	3 and 4	...	...	...	2.88
1 and 5	...	...	...	8.43	3 and 5	...	...	...	0.67
2 and 3	...	...	...	6.955	4 and 5	...	...	...	2.21

*Observations.*—An inspection of Table IV. brings out a number of points:—

(1.) There is a distinct difference between Lots 3 and 4 and Lots 1, 2, and 5 in the first week. The only explanation of this which suggests itself is that the sheep in pens 3 and 4 may have obtained somewhat more nutritive value than did the others from the dry grass and herbage in the pens. As, however, this was not very extensive, and as 20 sheep had been held in each pen prior to the commencement of the experiment, it appears unlikely that this could have produced the effect noted.

(2.) After the first week there was a fairly consistent and rather rapid fall in weight in all lots. This led to the conclusion that, although unlimited wheaten straw was provided, all rations were inadequate to supplement this, and on the 14th April they were all increased by half. This alteration had the desired effect of arresting the rapid general loss in condition.

(3.) The rations appear to be divided into two fairly distinct groups:—

- (a) Rations 1 and 2, the unmixed dry feeds.
- (b) Rations 3, 4, and 5, the mixed feeds containing silage.

It will be noted that after the increase in the rations there was still a steady decrease in weight in Lot 1 and to a less extent in Lot 2, and this, in spite of the fact that Lot 1 were rejecting part of their ration.

*Discussion.*—Reference to the statistical analysis of the results will show that the difference between Lot 1 and Lots 3, 4, and 5, and between Lot 2 and Lots 3 and 5 are definitely significant, while the difference between Lot 2 and Lot 4 is very probably also significant. In the case of the other pairs of lots, the differences may be due to chance, and cannot be regarded as of any significance.

As in the previous experiment (1), a study of the analyses of the feeds seems to supply an explanation of the grouping noted above. Working on the same assumptions as previously, the starch equivalent and nutritive ratio for each ration were calculated, and these figures are presented in Table VI.

TABLE VI.  
*Starch Equivalents and Nutritive Ratios.*

	Lot No.				
	1. Oaten Hay.	2. Oats.	3. Oats + Silage.	4. Oats + Silage.	5. Wheat + Silage.
S.E.—					
1st Period ...	·56lbs.	·31lbs.	·36lbs.	·32lbs.	·38lbs.
2nd Period ...	·84lbs.	·46lbs.	·54lbs.	·48lbs.	·57lbs.
N.R. ...	16·2	14·5	10·3	11·8	10·4

As before, it will be seen that there is no obvious connection between starch equivalent and changes in live weight, but in the case of nutritive ratios, the correlation is most marked. It will be noted that the nutritive ratio of all rations is fairly wide, but if the rations are arranged in order from the narrowest to the widest, viz., 3, 5, 4, 2, 1, they are seen to stand in the same order as when arranged accordingly to losses in live weight.

This marked relationship bears out the observation made in the 1930 experiment, that lack of protein is the limiting factor rendering some supplements unsatisfactory.

It will be noted that oats alone in the 1931 experiment did not give nearly as good results as in 1930, but a comparison of the analyses and nutritive ratios of the two samples immediately makes this clear, the 1931 sample being considerably lower in protein and higher in fibre than was the case in 1930 (see Table VII.).

TABLE VII.  
*Analyses and Nutritive Ratio of Oats.*

	1930.	1931.
Protein ...	9·58	5·91
Fibre ...	11·03	14·46
N.R. ...	8·8	14·5

One of the main lessons to be drawn from the experiments, therefore, would seem to be that a ration supplementary to dry feed should be fairly high in protein.

*Costs.*—Turning now to the important question of the cost of the various rations. As before, no reliable figures are available for Western Australian conditions, so figures are again taken from Turretfield, South Australia (2) for oats, wheat, and hay, and a figure calculated on a general average in the case of silage.

The figures taken as representing the average cost are as follows:—

Oats, per bushel—2s. 7d.

Wheat, per bushel—4s. 10d.

Cereal hay, per ton—£2 19s. 6d.

Silage, per ton—17s.

The Turretfield figures may perhaps be criticised as being unduly high, but it must be remembered that rent, interest on capital, and wages of manager and staff are all included in this figure. In any case, costs of production will vary from farm to farm, and it is impossible, therefore, to give an exact figure to fit all cases.

From the above figures the cost per lot per day, and for the whole period after the increase in rations, have been calculated, and the results are presented in Tables VIII. and IX.

TABLE VIII.

*Cost of Rations per Lot of Twenty Sheep per Day.*

Lot No.			Oats.	Wheat.	Hay.	Silage.	Total.
			d.	d.	d.	d.	d.
1	...	...	...	...	11·95	...	11·95
2	...	...	11·63	...	...	...	11·63
3	...	...	3·10	...	...	4·92	8·02
4	...	...	8·53	...	...	1·64	10·17
5	...	...	...	7·25	...	3·28	10·53

TABLE IX.

*Total Cost of Rations, 14-4-31 to 4-7-31.*

Lot No.					Cost.		
					£	s.	d.
1	...	...	...	...	4	1	8
2	...	...	...	...	3	19	6
3	...	...	...	...	2	14	10
4	...	...	...	...	3	9	6
5	...	...	...	...	3	11	11

At the prices quoted it will be seen that the rations incorporating silage are the lowest in cost, while oats alone and oaten hay are the two dearest, the latter owing to the fact that it was fed in relatively greater quantity than the other rations. It is also worthy of note that the ration, including wheat, compares quite well with the rations containing oats. Taking live weights into consideration, it again definitely appears that a mixture of silage and cereal grain is the most suitable supplement for maintenance of sheep on dry stubble.

*Wool.*—At the close of the experiment all the sheep were examined by a competent woolclasser for any change in growth.

In Lot 1 there was a definite fining off of the fibre in several sheep; in Lot 2 there was little change, while in Lots 3, 4, and 5 there was evidence of slightly more character in the wool.

*Health.*—The health of all the experimental animals was good throughout.

## SUMMARY AND CONCLUSIONS.

1. Experiments were carried out in the supplementary feeding of sheep with five lots of twenty sheep each. The experiments commenced on the 25th February, and covered a period of just over eighteen weeks ending on 4th July. No sheep died during the experiment.

2. The rations tested were—oaten hay, fed long; oats; oats, plus silage, with a small amount of oats; oats plus silage, with a larger quantity of oats and a proportionately smaller amount of silage; and wheat, plus silage. The amounts fed were calculated to be approximately equal in energy value, and were fed as a supplement to a basal ration of wheaten straw.

3. Of these five rations, oats, plus silage, with the smaller proportion of oats, and wheat, plus silage, gave the best results, followed closely by the other, oats, plus silage ration. Oats alone was not so good, while oaten hay was the worst of the five.

4. As in the 1930 experiment, it seems almost certain that the factor limiting the value of certain of the rations is the protein content. This would explain the divergent result obtained with oats in the two years, the sample used in 1931 being much inferior in quality to and lower in protein content than the 1930 sample.

5. On the basis of the prices quoted, the two rations, including oats and silage, are the cheapest, while wheat, plus silage, is little more expensive. Taking account of the results in both 1930 and 1931, it seems safe to say that with silage of fair to good quality, a mixture of silage with fair average quality wheat or oats is a satisfactory supplement. Oats, if of poor quality, may not be a good supplement if fed alone; but oats of good quality would be quite satisfactory.

It will be seen, therefore, that in the case of the differences between Lot 1 and Lots 3, 4, and 5, and between Lot 2 and Lots 3 and 5, the odds are more than 100 to 1 against these differences being due to chance.

In the case of the other differences, the odds against their being due to chance are all less than 20 to 1, so that they cannot be regarded as being definitely significant. For the difference between Lots 2 and 4, however, the odds are over 10 to 1, so that it is probably not due to chance:

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- (1) Riches, J. H.—*Jour. Dept. Ag., Western Australia* 8 (Second Series), 279 (1931).
- (2) Perkins, A. J.—*Jour. Dept. Ag., South Australia*, XXXIV. 481, 585, 593 (1931).
- (3) Fisher, R. A.—*Statistical Methods for Research Workers*, London (1928).

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**TESTING MILK FOR BUTTER FAT WITHOUT THE USE OF A CENTRIFUGE.**

By A. B. ADAMS, B.Sc.Agr.

A method of determining the percentage of butter fat in milk without the use of a centrifuge was reported by B. Singh, in the *Jour. Cent. Bureau of Animal Husbandry and Dairying, India*, Vol. 2, No. 4. The following is an abstract:—

"In this method of testing milk for fat 11 c.c. of milk are placed in a Gerber tube and 5 c.c. of Fehling solution B added. One c.c. of a mixture of 55 parts of

isobutyl alcohol and 45 parts of methyl alcohol is added, the tube corked, inverted, shaken gently and the tube is then almost completely immersed in a water bath at 80 C. The tube is removed from the bath when the liquid inside is a deep orange, shaken and replaced in the water for three minutes. The cork is then removed, 5 c.c. of hot water poured down the sides of the tube, the cork is replaced, and the tube inverted gently and again placed in the water bath. In a short time the fat column appears and is easily read on the graduated scale."

As the quantities of reagent used in the method above reported are for use with Gerber bottles and as such bottles are not in general use in this State, the writer experimented with the method, using Babcock bottles and adjusting the quantities of the reagents to the larger quantities of milk used in the Babcock bottles.

Fehling solution B is the alkaline solution; it is prepared as follows:—

173 grammes of sodium potassium tartrate (Rochelle salt) and 51 grammes of sodium hydrate are dissolved in 500 c.c. of distilled water or rain water.

The following procedure was adopted when testing milk in Babcock bottles by this method:—

17.6 c.c. of the milk were pipetted into the bottle and to this were added 8 c.c. of Fehling's solution B and 1.6 c.c. of the mixture of 55 parts of butyl alcohol and 45 parts of methyl alcohol. The mixture was then gently shaken until the casein appeared to be dissolved. The bottle was then placed in a water bath at 80deg. C. (An empty 5lb. jam tin, one of the tall type, is very suitable as a water bath as it is about the same height as the test bottles.) The temperature must be maintained at 80deg. C. (176deg. F.). When the liquid in the test bottle is a deep orange, but not before, the bottle is removed from the water bath, shaken and replaced in the water bath for three minutes. Hot water was then added to bring the liquid to the bottom of the neck, after standing in the water bath for two minutes a second portion of hot water was added to the test bottle to bring the fat into the graduations in the neck of the bottle. It was then allowed to stand in the water bath for three minutes and then removed and the percentage of fat read off.

The writer checked this method by comparing it with the usual Babcock test, *i.e.*, adding 17.5 c.c. of sulphuric acid to 17.6 c.c. of milk, shaking the mixture until the casein is dissolved, centrifuging for five minutes, adding hot water to the bottom of the neck of the test bottle, centrifuging two minutes, adding hot water to bring the fat column into the neck of the bottle and centrifuging for another minute. Then removing the bottles from the centrifuge and placing them in a water bath at 180deg. The results obtained without the centrifuge proved to be comparable with those by the Babcock test.

As a further check, when Mr. Ruthven, the Government Herd Tester, was paying his usual monthly visit to Muresk College, the writer tested some of the milks that were under official test and obtained comparable results.

If a burette for the measurement of the reagents is not available a minim measuring glass may be used, taking 135 minims of the Fehling's and 27 minims of the alcohol mixture.

N.B.—In using the method the water in which the test bottles are immersed must be maintained at 176deg. F. The hot water must not be added to the test bottles until the liquid has become a deep orange colour.

It is not suggested that the method has any greater accuracy than the Babcock method nor that it would have any advantages over that method in the factory. For testing a few animals on the farm, however, the small amount of apparatus required and the elimination of acid, also the fact that the water bath can be placed on the stove and attended from time to time in place of centrifuging, are distinct advantages.

## HOME SCOURING OF WOOL.

H. McCALLUM, Sheep and Wool Inspector.

The main factors in successful scouring of small lots of wool are:—

Good supply of water—rain-water for choice.

Good soap, potash preferable, or non-alkaline.

Use of warm, not *hot* water.

Quick draining and drying.

No wringing or twisting of wool.

All wool should be well shaken to remove loose dust. Very stained and dirty pieces must be removed. Commence on the cleanest wools.

Prepare liquor by first shredding soap into a small quantity of hot water and thoroughly dissolving, allowing about 8 ozs. of soap to 4 gallons of water.

Three tubs are necessary. In the first two mix the prepared soap liquor with warm water at about 115 degrees Fah., and in the third use clean warm or cold water. The soapy waters should have a soft feeling and give a nice lather without becoming all suds. Wool that has been hard pressed should be opened up and allowed to stand for a short time before putting into the bath. Only sufficient wool to be well covered with water should be put in at one time. Keep wool moving in the bath for five to ten minutes, lift out on to draining board, squeeze, and put into the second tub—repeat process and then rinse in the third tub. All traces of soap must be removed. Squeeze out as dry as possible, shake out lightly, and then place out on racks of netting or calico sheets to dry. Choose a fine warm day and place the racks out of the direct rays of the sun, but in a position where there is a good draught of warm air. Turn the wool frequently to facilitate drying, as the quicker the moisture is removed the better will be the quality of the finished product, but great heat must not be used for this purpose. The wool must not be twisted or wrung.

The potash content of the wool yolk materially assists in the scouring, and the drainings from the first and second tubs should be permitted to run back. The temperature of the water must be kept even and a little more of the prepared liquor added and well mixed before each lot of wool is put through. After several lots of wool have been washed, the rinsing water can be added to that in the first and second tubs and a fresh lot used for rinsing.

Very greasy, dirty pieces require the first and second waters slightly hotter, but at no time must water be used for washing wool hotter than the hand can be borne in. The third tub may be of warm clean water, and the final rinse can be cold.

For very hard water caustic soda powder, 1 oz. to 8-10 gals., may be added to the first washing water.

Rinsing of all wools may be carried out in a running stream.

The handling of locks and pieces will be facilitated if "holders" are constructed to fit inside the tubs. These should have perforated bottoms and holes at the sides and be a few inches smaller than the tub, so that the water can move around the sides and come up through the bottom. Wooden boxes with the tops and bottoms removed and wire netting fixed across the bottom opening give satisfactory service. Wire baskets are also very suitable.

If an ordinary clothes wringer or mangle is available it will provide a very quick and satisfactory means of squeezing out the water between the washings and prior to spreading out to dry. A long piece of calico, butter muslin, or similar material, twice the width of the wringer or mangle, will be found of value if folded double and the wool placed between, as it prevents the fibres winding round the rollers.

## THE VALUE OF HONEY AND ITS USE.

H. WILLOUGHBY LANCE, Apiculturist.

Few persons realise the variety of purposes for which honey can be used with advantage. The common idea seems to be that honey should be eaten on bread, and that occasionally as a change from other food and as a relish. As a matter of fact, honey should be part of the daily diet of the majority of persons.

Sugars of various kinds are what are termed carbo-hydrate foods and are heat and energy producing, and a certain amount of such food is necessary daily, if the body is to function properly. Sugars (of which there are many forms), however, cannot be assimilated by the body and passed into the blood stream until their chemical formation has undergone a change. With the majority of sugars, this change has to take place in the stomach of the person eating the sugar. This process must necessarily use up some of the juices of the stomach.

It is, therefore, quite clear that if we can introduce the necessary sugar into the stomach in its changed state, scientifically known as "inverted," we shall save the stomach much work and the juices will be available for other purposes. Ordinary refined white sugar is not "inverted." Nectar, as it is gathered from the flowers, is a sweet sugar syrup, which is inverted by the field bees when carrying it home to the hive in their honey sac and storing it in the honey cells. The complete inverting and ripening takes place in the honey comb, and it is not until the ripening is completed that the bees cap the cells over with wax.

Nature has provided for the sustenance of the bees in a wonderful way. The honey stored in the hive is their winter food, when nectar straight from the flowers is not available. It must be remembered that bees in most countries cannot gather honey during the cold wet weather, and in many cases are confined to the hive for several months. During this period it is important that the stomach of the bees should have as little work to do as possible, so that they may remain in a semi-dormant state. If their food were stored in the form of nectar, the eating of it would use up energy; whereas, being already inverted, it is ready for immediate assimilation. Also, if it had not been ripened, it would have fermented and caused intestinal trouble and disease.

The bees having done the necessary work in their own interests, it is for us to take advantage of it and to use honey instead of cane sugar, whenever possible. It must also be remembered that cane sugar is nothing but sugar, whereas honey contains many of the mineral salts required by the human system, amongst them being phosphoric acid, iron, lime, potash, soda, etc., the proportion of each varying according to the source of the honey.

Honey, in addition to being an important food, also has great curative and medicinal value. It is also the one food in which no disease germs, that attack the human system, can exist. Honey is the best food with which to start the day. Anyone commencing the morning meal with porridge, "Weeties," or other prepared cereal food, should drizzle honey over it in place of sugar. Very few persons will desire to go back to sugar.

A generous supply of an easily digested carbo-hydrate food is considered to be the best stimulant in cases of acute fever, prolonged anæsthesia, for a short fast, mountain climbing and athletics, or any physical emergency. The following extract from the "West Australian" of August, 1931, proves the value of honey as a sustaining food:—



## SUSTAINED BY HONEY.

*Himalayan Climbers' Experience.*

LONDON, Aug. 2.—The British Himalayan Expedition has sent a letter to the New Zealand Honey Board from the expedition's camp in Sikkim, stating that it has returned to its base on the completion of successful research work in the Himalayas. Once, the letter states, the party *lived for 10 days solely* on New Zealand honey, owing to their supplies having been raided. The looters fortunately missed seven jars of honey, packed in a haversack.

We will first deal with Honey in Cooking, giving a few recipes, and then give information of other uses.

## HONEY FOR COOKING.

When using honey in the place of sugar for cooking, it must be remembered it cannot be used in exactly the same way as sugar. Honey contains a certain proportion of water, sometimes as much as 18 per cent., so that its sweetening value is often less than sugar, and yet in some cases less honey is required than sugar, some honeys being sweeter than others and having more flavour. It may be necessary, therefore, to vary somewhat the quantity of honey given in the recipes according to taste.

Honey cooking requires somewhat more care than usual as honey burns quicker than sugar. It must be remembered that there are many different flavours in honey and that the constituents vary, consequently the honey that is suitable for one kind of cooking may not be so suitable for another. For instance, for a honey sponge, a light-bodied mild flavoured honey is best, but for ginger nuts a dark, heavy, strong-flavoured honey is excellent.

When honey becomes granulated, it can be made liquid again by standing it in hot water at not more than 140deg. F., or just as hot as the hand will bear. If it is placed over a fire or flame, the jar or tin should stand on a piece of wood in the receptacle containing the water, otherwise the flavour will be spoilt. The quicker it is cooled after heating, the longer it will remain in liquid form.

The following are a few simple recipes which have all been tested out:—

*Nut Bread Roll*—

1 cup finely cut nuts;

$\frac{1}{2}$  cup honey.

Blend to form a spreading paste. Cut bread in slices full length of loaf. Spread bread with butter, then with paste, and roll as for jelly roll. Wrap each roll in waxed paper and tie to keep intact. Let stand one hour or longer, remove paper, and cut each roll in three slices. Each loaf makes 15 rolled slices.

*Fruit Cake*:—

Warm  $\frac{1}{4}$  lb. nut lard and  $\frac{1}{2}$  lb. honey, add 2 well beaten eggs; small quantity cinnamon and nutmeg; 6 ozs. raisins; 6 ozs. currants, and sufficient flour to make a stiff batter. Well stir, drop into hot gem pans and bake in slow oven.

*Honey Cake*—

1 lb. self-raising flour;

$\frac{1}{2}$  lb. butter;

$\frac{1}{2}$  lb. raisins;

$\frac{1}{2}$  lb. mixed peel;

4 tablespoons honey;

Milk—about 1 gill;

2 eggs;

2 tablespoons sugar;

Pinch of salt;

Grated rind of a lemon.

*Method.*—Sift flour and cream butter with sugar; warm honey in milk. Mix all dry ingredients together, gradually add butter and sugar, milk and honey, and well beaten eggs. Place in papered tins and bake in moderate oven for about 2 hours.

*Ginger Cake—*

¼ lb. butter or lard;  
½ lb. honey;  
2 eggs;  
1/3rd pint sour milk;  
2 ozs. finely chopped preserved ginger.

Mix and add gradually two cups flour, beating well all the while. Line tin with greased paper and pour in mixture. Bake in moderate oven 40 minutes.

*Honey Shortcake—*

½ lb. flour, add 1 teaspoon baking powder. Rub in ¼ lb. nut lard or butter, 4 ozs. honey. Make into a paste with about 1/3rd pint milk. Roll out, cut into desired shape, and bake in hot oven.

• *Raisin Cake—*

1 lb. self-raising flour;  
½ lb. butter;  
½ lb. raisins;  
½ lb. mixed peel;  
4 tablespoons honey;  
About 1 gill milk;  
2 eggs;  
2 tablespoonsful sugar;  
Pinch of salt;  
Grated rind of lemon.

Sift flour and cream butter with sugar, warm honey in milk. Mix all dry ingredients together, gradually add butter and sugar, milk and honey, and well beaten eggs. Place in papered tins and bake in moderate oven about 2 hours.

*Honey Gems—"A"—*

6 ozs. honey;  
1 pint sour milk.

Well mix with egg whisk, adding a little at a time, sufficient flour to make into soft dough. Flavour as desired, drop in hot gem pans, and bake 20 minutes.

*Honey Gems—"B"—*

1 egg;  
2 cups flour;  
2 teaspoons baking powder;  
1 cup cold water;  
½ cup sugar;  
Flavouring.

*Method.*—Well beat egg, sieve flour and baking powder, add butter, sugar and honey, essence, then add water. Stir well, drop in spoonfuls on baking dish or tray. Bake 10 minutes.

*Honey Sponge Sandwich—*

- 1¼ cups flour;
- 2 eggs;
- ¾ cup honey;
- 2 tablespoonfuls butter;
- 2 tablespoonfuls hot water;
- ½ teaspoonful baking soda.

Beat butter to a cream, add eggs not previously beaten, dissolve soda in hot water, then mix well with the honey which has been previously warmed, add it to the above ingredients, lastly add the flour and flavouring. Bake to a golden brown for about 10 minutes. Form into a sandwich with honey-lemon butter.

*Gingernuts—*

- 1 cup strained honey;
- 1 cup sugar;
- ½ cup melted butter;
- 1 egg;
- 2 teaspoonfuls baking powder;
- 2 teaspoonfuls ginger;
- 2 cups flour;
- 1 cup chopped nuts.

Mix honey, sugar, melted butter and beaten egg. Sift baking powder and ginger with flour. Add nuts to flour after sifting. Stir well into other ingredients. Bake in moderate oven 25 minutes.

*Honey Pudding—*

- 1 oz. cornflour;
- 4 ozs. honey;
- 5 ozs. breadcrumbs;
- 2 ozs. butter;
- Grated rind and juice of ½ lemon;
- 1 gill milk;
- 1 egg.

Boil milk, pour on the cornflour, previously blended with a little water. Return to saucepan and cook eight minutes. Add butter and yolk of egg, beating in thoroughly. Put breadcrumbs and grated lemon rind into basin. Stir in honey, warming if necessary, then cornflour, sauce, and lemon juice, and lastly stiffly beaten white of egg. Pour into butter mould. Steam 1 hours. Serve on hot dish with melted honey.

*Apple Pudding—*

Stew 3 or 4 apples, using honey to sweeten.

- ¼ cup honey;
- 2 eggs;
- 2 tablespoonfuls butter;
- 1 cup self-raising flour.

Butter a mould and put mixture in tablespoonful and pieces of apples in layers. Fill up in this way. Cover and steam 1½ hours. Serve with sauce made of:—

- 1 dessertspoonful cornflour;
- 1 egg;
- 1 dessertspoonful honey;
- 1 cup milk;
- Flavouring to taste.

## PIES.

*Orange Tart or Pie—*

2 dessertspoonfuls cornflour;  
Juice 2 oranges;  
1 lemon;  
2 tablespoonfuls honey;  
Yolk 3 eggs beaten.

Lime plate or dish with honey pastry. Bake. Mix cornflour with cold water and add 1 cup boiling water. Stir in orange and lemon juice and honey. When boiling add egg yolks. Stir until thick. Then put this on pastry. Beat whites of eggs stiffly with a little honey added. Spread roughly on pie and bake slightly (just enough to set).

*Pumpkin Pie—*

$\frac{3}{4}$  cup honey;  
3 eggs;  
1 teaspoonful ginger;  
1 teaspoonful cinnamon;  
1 tablespoonful butter;  
 $1\frac{1}{4}$  cups cooked mashed pumpkin.  
1 teaspoonful salt;  
1 teaspoonful flour;  
 $\frac{1}{2}$  teaspoonful corn starch.  
 $1\frac{1}{2}$  cups milk.

Sift dry ingredients. Then beat in eggs lightly. Slightly warm milk and blend with honey. Add to egg and flour mixture and stir until smooth. Pour into plate lined with pastry or make individual pumpkin tartlets. Just before pie is served top with honeyed whipped cream.

## MIXED FRUIT SALAD.

Diced fresh fruit, orange, apple, banana, pears, peaches, apricots, pineapples, cherries, grapes, or lettuce with a little honey drizzled over it.

*Orange Krisp Salad—*

3 large oranges;  
Honey;  
Rice krispies or puffed rice, or cocoanut;  
Lettuce.

Peel oranges, cut into slices crosswise, and remove centre core. Have honey in flat bowl or saucer and set on top of teakettle or in warming oven so that it becomes slightly warmed. Dip orange slices in warm honey and then in saucer of rice krispies or puffed rice, or cocoanut, so that both sides will become coated. Allow four or five slices to a salad, arrange on individual beds of lettuce, and garnish with dots of cherry pieces.

## COOKED FRUITS.

*Honeyed Apples or Pears—*

Wipe well with damp cloth, remove cores. Place in casserole or pie dish. Put 1 dessertspoonful of honey in centre of each apple or pear. Bake slowly until skin cracks and apples are tender. Baste well with honey once or twice during cooking. Serve hot or cold in dish in which they were cooked.

## SAUCES, ETC.

*Sauce for Puddings—*

- 2 tablespoonfuls honey;
- 1 tablespoonful water;
- Juice and grated rind of  $\frac{1}{2}$  lemon.

Boil one minute.

*Salad Dressing—*

- 1 tablespoonful candied honey;
- 2 tablespoonfuls thick sweet cream;
- 1 tablespoonful vinegar;
- $\frac{1}{4}$  teaspoonful mustard.
- Pepper and salt to taste.

No cooking. Beat together. Excellent over salad made from chopped apples and celery.

## SWEETS.

*Honey Toffee—*

No. 1 Recipe: Boil honey until it hardens when dropped in cold water. Pull until it becomes white. A pound requires about 20 minutes boiling and stirring. Great care must be exercised not to burn the honey.

## No. 2 Recipe:

- 2 cups sugar;
- 1 tablespoonful vinegar;
- $\frac{1}{2}$  cup honey;
- 1 tablespoonful cold water;
- 1 tablespoonful butter.

Boil ingredients for about 20 minutes and test for hardness.

## No. 3 Recipe:

- 1 cup honey;
- $\frac{1}{3}$ rd cup cold water;
- 1 cup sugar;
- 1 teaspoonful vanilla.

Boil water, sugar and honey together and test for hardness. Then add vanilla. Put on buttered dish to cool, then pull until white. If pan in which honey is cooked is buttered around the top it will not boil over.

*Honey Jubes—*

- 1 cup water;
- 1 large lemon;
- 1 cup honey;
- $1\frac{1}{2}$  ozs. gelatine.

Dissolve gelatine in hot water, add honey that has been previously warmed, also lemon juice. Stir till thoroughly mixed, put away till cold, when it can be cut to desired size.

*Nut and Honey Drops—*

- $\frac{3}{4}$  lb. sugar;
- 2 ozs. nuts;
- 4 tablespoonsful condensed milk;
- 2 tablespoonsful honey;
- White of 1 egg;
- 3 tablespoons cold water.

Put sugar, condensed milk and water into pan and heat until temperature of 223deg. is reached. Add honey and cook to 240deg., then take from fire and add beaten whites. Beat one minute and add chopped nuts. Place in spoonful on waxed paper.

*Honey Caramels—*

- 1 lb. honey ;
- 1 lb. sugar;
- 3 tablespoonsful new milk;
- Flavour with vanilla.

Boil until it hardens when a small portion is dropped into cold water. Pour into greased shallow dish, as it cools, cut into desired shapes and wrap in grease-proof paper.

## HONEY DRINKS.

It is not generally realised that honey makes an excellent stimulative drink, made either with hot or cold water. One objection to using honey in cold drinks is that it takes some time to dissolve. This may be got over by making it into a—

*Honey Syrup* by dissolving two parts of honey in one part of hot water. This may then be bottled and is ready for use the same way as raspberry or other fruit syrup. This will keep good without fermenting for many weeks.

*Honey Lemon Drink—*

The juice of half a lemon and one or two dessertspoonsful of honey syrup, according to taste, in a glass of water.

*Honey Orange Drink—*

The juice of one orange and one or two dessertspoonsful of honey syrup, according to taste, in a glass of water.

*Vitality Cocktail—*

- 2 oranges (juice);
- 1 egg (yolk);
- $\frac{1}{2}$  lemon (juice);
- 2 tablespoonsful honey.

Beat all together and drink each morning.

*Cocoa, Coffee, and Chocolate—*

Each is improved by using honey in the place of sugar.

*Ginger Beer—*

- 5 lbs. sugar;
- $\frac{1}{2}$  pint lemon juice;
- 5 gallons water;
- $\frac{1}{2}$  lb. honey;
- 5 ozs. bruised ginger.

Boil ginger half an hour in 3 quarts of water, add sugar, lemon, and honey, with the rest of the water. Strain through a cloth. When cold add white of an egg, 1 teaspoonful essence lemon, small teaspoonful essence ginger. Stand in a cask four days and then bottle.

*Honey Beer—*

- 40 lbs. honey for strong beer;
- 30 lbs. honey for mild beer;
- 2 lbs. hops for bitter beer;
- 1½ lbs. hops for sweet beer;
- 2 lbs. extract of malt;
- 1 cup brewer's yeast, or 1 cake (2 ounces) compressed yeast.

Place hops in muslin bag and boil in water for half an hour in a clean copper, if available. Strain off liquid and pour hot into keg, which has had honey and malt previously added. Stir until all is dissolved, then add cold water to fill keg within one inch of bung hole. Add yeast when contents are luke warm. By next day fermentation should have set in and be flowing well over keg. This lasts about a week or ten days in warm weather. As the contents of barrel subside, add a little water daily to keep it full. This enables sediment to work over, instead of going back into beer. When action has stopped, cork up tightly, and leave about two weeks or longer. Then the beer is ready to drink or bottle. Bottled beer is better than draught, as it has a fine head when opened, and is not liable to go sour. Capsule tops are preferable to corks.

*Honey Mead—*

Beuhne's recipe is:—60 lbs. honey, 18 lbs. raisins; boil 10 or 15 minutes in water sufficient to fill an 18-gallon barrel; ½ pint yeast. Let it work for two or three weeks, paste a piece of cheese cloth over the bung to keep out vinegar flies. It will boil or hiss for two or three months (according to the amount of honey used). Then, when it is perfectly quiet bung up tightly for seven to twelve months—the longer the better. If no raisins are used, then up to 90 lbs. honey had better be used. Clearing can be done with white of eggs or a packet of isinglass.

## MEDICINAL.

Honey is a most excellent remedy for many ailments, and a few of its uses are given hereunder:—

*Asthma—*

- 1 oz. castor oil;
- 4 ozs. honey.

Mix and take one tablespoonful night and morning.

*Colds—*

- Juice of half a lemon;
- 1 or 2 teaspoonsful of honey.

in glass of hot or cold water. Take night and morning and at intervals if necessary. One of the best medicines for colds, influenza, and many kinds of fever.

*Ointment—*

Honey and flour mixed into thin paste, warmed, spread on linen rag and applied to piles, abscesses or boils, quickly brings them to a head and lessens the tension and pain.

*Salve—*

- 2 tablespoonsful of honey;
- Yolk of one egg;
- Sufficient flour to make into paste.

Excellent for running sores of long standing, boils, or sores with proud flesh.

*Borax Gargle for Sore Throat—*

- 1 teaspoonful of borax;
- 2 teaspoonsful of honey;
- 1 glass of water.

Mix together and gargle frequently.

*Honey and Vinegar for Sore Throat—*

Equal quantities of honey and white vinegar or honey vinegar by preference. Warm the honey and stir vinegar into it. Put into bottle and cork. Specially soothing for coughs and colds, and delicious to taste.

*For Croup—*

Honey is an excellent remedy, giving sure and excellent relief.

*For Burns—*

A paste of honey and soda, spread on the burn and covered with cotton wool and cloth, quickly relieves the pain.

*For Piles—*

Honey spread on the place and covered with cotton wool and cloth is an excellent remedy.

*For Sleeplessness—*

Two teaspoonsful of honey dissolved in a glass of hot milk and sipped slowly is an excellent sleep producer. It has succeeded where other methods fail.

The above uses and recipes are only a few of the many ways in which honey plays an important part, but it is impossible, without writing a large book, to give them all or explain all that is known about the sources and value of honey.

## LINSEED OR "FLAX" AND ITS CULTIVATION.\*

GEO. L. SUTTON, Director of Agriculture.

The "flax" referred to is that which produces the grain known as linseed, and the fibre from which linen, canvas, duck and strong cordage is produced. Botanically the plant is known as *Linum usitatissimum*. It is an annual, and is quite distinct from "New Zealand flax," which is a perennial, and botanically known as *Phormium tenax*, and which is used for the manufacture of rope and twine.

The principal use for the grain produced by this plant is the manufacture of linseed oil, which is so largely used for mixing with paints. The grain contains from 25 to 40 per cent. of oil. It is a valuable food for horses, cows and calves, and is specially valuable for supplementing the skim milk fed to calves. Because of the oil it contains it is a laxative, and this makes it specially useful in cases of illness. It should, however, be used sparingly. Because of the high commercial value of the oil in the linseed grain, the whole grain is rarely used as a food for stock. After the oil is extracted from the grain a residue is left which is known as Linseed Cake, Linseed Nuts, or Linseed Meal, which is an excellent stock food. As a source of protein for stock, it is more valuable than the whole grain, and is easily and thoroughly digested. Its qualities are extolled thus by Henry and Morrison † : "There is no more healthful food for limited use with all farm animals than linseed oil-cake or oil meal, with its rich supply of crude protein, slightly laxative oil and its mucilaginous soothing qualities. Its judicious use is soon apparent in the pliable

\* Flax and its Cultivation—Geo. L. Sutton, 1919; Bulletin 58—Revised and reprinted.

† Feeds and Feeding, 1917—Henry and Morrison.



skin, the sleek oily coat and the good handling quality of the flesh of the animals receiving it. It is, therefore, most useful as a conditioner for run-down animals." A small amount of linseed meal is helpful in the rations for horses and dairy cows.

The composition of linseed and linseed meal are given in Table 1 hereunder\* :—

TABLE 1.

	Digestible Constituents.					
	Crude Protein.	Pure Protein.	Oil.	Carbo-hydrates.	Fibre.	Nutritive Ratio.
Linseed Cake ...	10·4	18·1	34·7	18·3	1·8	1 : 5·5
Linseed Cake—English Made	25·3	23·9	8·7	28·5	4·3	1 : 2·2
Linseed Cake—Foreign	27·8	26·3	9·1	25·8	4·3	1 : 2·0

Because of its high protein content and consequent narrow nutritive ratio, linseed cake, linseed nuts or meal is a very suitable complement for mixing with more carbonaceous concentrates like maize, barley, wheat, and oats when the food is required for milking cows. In a mixture of linseed cake and oats in equal parts, the proportion of digestible protein to the other digestible nutrients is similar to that in bran. The food value of the mixture is greater, however, than an equal weight of bran, 100 lbs. of the oats and linseed mixture being equal to 160 to 170 lbs. of bran.

Grain can be produced under warmer and drier conditions than can good fibre of satisfactory length, and it is likely that satisfactory grain crops can be obtained in many parts of the Wheat Belt, even if flax for commercial fibre cannot be grown there.

In the 1919-20 season farmers' trials with flax were conducted throughout the State. It was found that the sowing, through unavoidable causes, had on the whole been on the late side, and the seed, which had to be imported, proved very weedy. Despite these two set-backs there was sufficient evidence to show that flax with long enough fibre can be produced in this State. It is apparent that farmers accustomed to grow wheat, oats, or potatoes by clean and careful methods, can grow flax, but their methods must be better than the average.

The trials with fertilisers indicated that on soils of average fertility, the usual dressing of superphosphate was all that was required. On other soils an application of a nitrogenous fertiliser produced longer crops. The linseed grain produced appeared less plump and bright than the imported Victorian sample, but on analysis the oil content proved to be very similar. The analysis of six samples of grain submitted to the Government Analyst and Agricultural Chemist for oil determination were as follow :—

Grain grown by—	Percentage of oil.
Victorian (imported) .. .. .	37.47
P. Duggan, Northam .. .. .	35.62
Chapman Experiment Farm .. .. .	35.78
P. Boucant, Boyanup .. .. .	34.59
E. Gee, Highbury .. .. .	39.22
C. Atheron, Lowden .. .. .	38.08

\* The Composition and Nutritive Value of Feeding Stuffs—T. B. Wood, M.A., and F. T. Hailan, Cambridge University Press.

The straw produced was sufficiently long for commercial purposes, and though it was not possible to ascertain definitely the quality of the fibre produced, there is no reason to believe that its quality was other than satisfactory.

In view of the result of these trials and subsequent experience, there is every reason to expect that linseed for grain can be grown satisfactorily and profitably in Western Australia, and that at least sufficient for the State's requirements should be produced.

In Table 2 will be found details furnished by the Government Statistician relating to the importation of linseed and linseed products in Western Australia as at 30th June, 1930:—

TABLE 2.

*Linseed and Linseed Products imported into W.A. for the year ending 30th June, 1930.*

	Quantity.	Total Value.
		£
Linseed ... .. centsals	1,087	1,019
Linseed Meal ... .. "	7,693	4,791
Linseed Cake, Nuts, etc. ... .. "	12,256	7,587
Linseed Oil ... .. gallons	64,053	16,061
		£29,458

Based upon an average yield of approximately  $5\frac{1}{2}$  centsals (550 lbs.) per acre, it is estimated the produce of at least 4,000 acres of linseed are necessary to meet the State requirements. Pending the establishment of a crushing mill, it would be necessary to export our crop to the oil mills of the Eastern States. There is insufficient linseed grown in the Commonwealth to meet its requirements, for the importations of linseed for the year ending 30th June, 1930, amounted to 487,968 centsals, valued at £459,247.

Though linseed can be grown on a variety of soils, the most suitable soils are well-drained chocolate loams or black soils rich in organic matter. A suitable climate and thorough preparation of the seed-bed are of more importance than the selection of a particular type of soil, unless the soil be poor and impoverished, in which case satisfactory results cannot be expected. Heavier soils usually give the best results. On sandy soils the fibre is usually short. Any soil capable of producing good crops of wheat, oats, barley or potatoes is suitable for the production of flax.

The thorough preparation of the seed-bed has a very important bearing upon the success of this crop. In preparing the soil for the flax plant, two things should be kept prominently in mind. These are:—

1. That weed growth seriously reduces the crop yield, and lessens the value of the straw for fibre production.
2. That the plant contains the fibre right throughout its length and, under Australian conditions, requires to be cut close to the surface of the ground.

The first of these requires that the treatment of the land should be such as will destroy weeds, and the second that the surface should be level and free from large lumps, so as to facilitate the harvesting of the straw with as little loss of length as possible; for, as the crop for fibre in Australia is harvested with the reaper and binder, the nearer the ground the binder knife can be set, the longer will the fibre be and therefore the heavier the yield, and because of its greater length, the better will be its quality.

In addition to being thorough, the preparation of the land should be deeper than is customary with wheat. The land should be fallowed in winter or spring and then worked down during the summer to a fine tilth. The methods adopted for the production of good crops of wheat or oats are suitable for the production of flax.

There are a number of varieties in existence, some of which have white blossoms and some blue. The variety which is generally used throughout Australia is a blue-flowering one known as "Blue Riga." It is likely that it is so called because the original seed came from the port of Riga, through which grain from the Baltic provinces is exported.

More recently a variety known as "J.W.S." has been introduced from Ireland and has given satisfactory results. This variety is the result of selection for long-stemmed fibre plants by Mr. J. W. Stewart, of Coleraine.\* It is probably a selection of "Blue Riga."

In view of what has been done in connection with seed selection in America and elsewhere, it is probable that improved strains of this variety can be obtained and distinct varieties specially suitable for either grain or fibre isolated and fixed.

At the Chapman Experiment Farm small pure lines of several strains have been selected. It was also found that an unfixed strain from some of the imported varieties produced much longer fibre than the ordinary varieties in cultivation, and also combined this quality with earliness. Under our conditions this may prove of special value for fibre in the earlier and drier districts.

The best time to sow is in early autumn, during the month of April and the early part of May. For the dual purpose crop of grain and fibre, the seeding should be about 60 lbs. of seed per acre. For fibre only, the rate of seeding is increased and in some instances to as much as 100 lbs. per acre. For the production of grain only, the rate of seeding is 40 lbs. and sometimes as low as 20 lbs. per acre.

When the crop is intended for fibre, the seed is preferably sown broadcast, but may be sown with the ordinary wheat drill. If sown with the latter, the seed tubes can with advantage be removed from the hoe or disc shoes and the seed allowed to fall and spread on the surface of the ground. When this plan is adopted the seed can be covered by subsequent harrowing. The seed, if sown deeply, fails to germinate and should therefore always be sown near the surface.

Professor H. L. Bolley, of the North Dakota Experiment Station, found that the cause of soil becoming "flax-sick" was due to a disease called "Flax wilt." Though the disease will not attack wheat, its effect on flax is similar to the "Take-all" of wheat. It attacks flax plants in all stages of their growth, and when the soil is badly infected, the young plants are killed before they reach the surface of the ground. It has, however, far more endurance than wheat "Takeall," for "Flax wilt" once established in the soil requires five or six years for its eradication. The disease is generally introduced into the soil by means of infected seed. This can be prevented by sprinkling the seed with a solution of formalin at the rate of 1 lb. formalin to 40 gallons of water, which is sufficient to treat 55 centsals of seed. Sufficient of the solution should be applied to evenly damp the surface of the seeds, after which they should be shovelled over once or twice and then covered with a sheet of bags or other material until dry enough to sow.

Treatment of all seed brought on to the farm is desirable, and as the presence of the disease has been reported in the Eastern States, and is known to exist in other parts of the world, the treatment of all imported seed to prevent flax wilt is essential.

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\* I. W. Seaton, B.Sc., Head of Plant Breeding Division, Ministry of Agriculture, Northern Ireland, in Balliere's Encyclopaedia of Scientific Agriculture, 1931.

Because of soils readily becoming "flax sick," flax has been regarded as an exhausting crop; but it has been shown to be no more so than other grain crops. It should, however, not be planted in the same ground in consecutive cropping years, but should be grown in rotation with other crops, and to prevent "flax sickness" now known to be due to the disease "Flax wilt"—all seed, and especially imported seed, should be treated with formalin.

As with the wheat and oat crop, superphosphate should be applied at time of seeding at the rate of about 1 to 1½ cwt. per acre. Experience indicates that the addition of about 25 per cent. of sulphate of ammonia to the superphosphate will be beneficial, and on sandy soils it is probable that potash manuring will also be required.

The crop, particularly that intended for fibre, must be kept free from strong-growing weeds like thistles, docks, wild radish, etc. These must be pulled out while the crop is short, for they not only reduce the yield but also give trouble in the after treatment of the straw for fibre. Even small low-growing weeds are objectionable if harvested with the straw, for they cause trouble in the subsequent treatment of fibre.

As the crop approaches maturity the stalks change from green to a golden yellow and the small leaves wither and drop off. The old method of pulling the crop for fibre by hand is only suitable for small areas and where labour is cheap and plentiful. It has been superseded in Australia by harvesting with the reaper and binder, and in parts of America with flax-pulling machines. If sufficient labour were available, it is probable that "pulling" would be the more profitable, for the plant contains fibre right down to the roots, and by pulling, greater weight, extra length, and a better quality fibre is obtained.

The following remarks by the Head of the Plant Breeding Station, Ministry of Agriculture, Northern Ireland, regarding methods of harvesting are of interest to prospective flax growers in Western Australia.\*

"From time immemorial it has been the custom to pull flax up by the roots rather than to cut it as in the case of corn crops. In Northern Ireland, at least, the chief reason for this procedure may well lie in the fact that the flax crop is, as often as not, badly laid before harvest time, but other reasons are also advanced. It is said that flax tends to become sour and deteriorates about the point of severance when cut, and cutting would undoubtedly be wasteful of the fibre. Pulling, too, enables the crop to be freed of such weeds as infest it, and which, if cut with the crop, would impede all subsequent operations.

"The increasing mechanisation of farm processes has left the flax crop singularly untouched, but this is due to the failure of invention rather than to the lack of it. Many flax-pulling machines have been tried, but none has proved commercially successful in Northern Ireland. Pulling by machine is usually achieved either by the action of rotatory combs intended to engage the crop immediately below the seed bolls, or by a system of revolving endless belts between which the growing plants are nipped. Either system might work well in a standing crop, though the second method would appear to have the disadvantage of pulling weeds too, but neither can be said to be successful where a lodged crop is concerned. So interwoven does a laid flax crop become, and so completely does its lying lack uniformity of degree or direction, the hardiest inventor may well quail before the task of its disentanglement by machinery.

"In countries such as Canada, where standing crops are usual, and where fibre, used as tow, is not more important than the seed crop, the combination reaper and binder is used in harvesting.

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\* I. W. Seaton, Bailliere's Encyclopaedia of Scientific Agriculture.

"The determination of a crop's fitness for pulling requires some nicety of judgment. In Ireland flax commences to bloom about the end of June, and the blooming period lasts for about three weeks. With its gradual cessation, growth in length also ceases, and the plant's energy becomes concentrated in the development of the seed bolls. Commencing at the base, the stem colour changes from green to yellow, and the basal leaves begin to fall off. The silkiest, glossiest, and strongest fibre results from pulling at the beginning of the period of stem colour change, but most farmers prefer to err on the safer side of over-ripeness and wait until the leaves have begun to fall, and the seeds to acquire a brownish tint in the capsule. Where both fibre and seed are saved, as in Belgium and Holland, the flax must, of necessity, be allowed to reach this stage of ripeness, but even in Ireland, where fibre is the only desideratum, it is estimated that for each farmer who pulls his flax too soon, five hundred pull theirs too late to secure the finest quality of fibre. A slight increase in yield is, however, gained by later harvesting. The crop is pulled by hand and tied in round sheaves or 'beets' of uniform size, the root ends being kept together.

"Uniformity in the size of 'beet' (sheaf) is important in the later processes. The value of the crop is enhanced by keeping separate flax of different lengths, since otherwise the shorter straws tend to fall from the bundles into the tow during the subsequent operation of scrutching, but such care in harvesting is seldom practicable.

"'Beets' (sheaves) should weigh from 7 to 10 lbs. each, and five pullers of average ability will harvest a statute acre per day. The beets are assembled in twelve-beet stooks, of which there should be eighty or ninety per acre.

"When it is intended to save seed from fibre flaxes, harvesting is usually slightly delayed. Any small depreciation in value of the fibre thus involved is more than compensated by the value of the seed when the undertaking is attempted in suitable climatic conditions which do not entail too much extra handling of the crop in the process."

Cutting with the reaper and binder is the only method at present available for Australian conditions. For reasons already stated, the crop should be cut as close to the ground as is possible, and for this plain knives are preferable to the serrated ones. The machine must be in good order, as the crop is much tougher to cut than the cereals. The sheaves should be small, as this facilitates thrashing, and should be placed in long double stooks rather than in round ones. As soon as thoroughly dry the sheaves should be stacked like wheat or oats.

Experienced growers in Victoria consider that 10 a.m. is quite early enough to commence cutting flax on any day; and that it should be cut only in clear weather, when it cuts the more easily. Loose straw is not desired at the flax mill, and therefore the sheaves should be tied securely. The band should be placed nearer the head than the butt, as the tendency is for the twine to slip towards the butt.

When a flax mill is available, the thrashing is invariably done at such by passing the bundles through rollers which revolve in opposite directions. When the straw is intended for fibre the thrashing should be done carefully, so as not to injure the fibre or disarrange the sheaves. If a crop which is intended for grain only has been harvested with a reaper and binder, the sheaves can be thrashed with an ordinary thrashing plant, or small lots with a flail.

Linseed does not shell readily, so that a crop required for grain can be left standing without risk of loss until all the seed bolls are ripe. It can then be harvested with a stripper-harvester. If the latter implement is used it may be desirable with some types to shut off portion of the blast by a canvas or other screen, otherwise the grain will be blown away.

The firm of H. V. McKay Massey Harris Pty., Ltd., has used its machines for harvesting thousands of acres of linseed both in America and New Zealand. Field engineers are watching the harvest in Australia closely this year and will collect very interesting information on the subject; but for those who wish to harvest their crop this year they have supplied the following information:—

“Three riddles altogether are used at the one time in the header: the standard 5/8in. riddle is used in the top of the riddle box, being fitted in the second rack in front, and the fifth hole from the top at the back; the 9/32in. lip riddle is used as the second riddle, in the fourth hole from the bottom at the back and the fifth rack in the front; and the 3/32in. x lin. slot punched riddle in the second hole at the back and the third rack in the front. Both lip riddles are to be fixed with the lips down and facing the blast. It will be necessary to purchase the 9/32in. and the 3/32in x lin. riddles, and the cost of those is 25s. each. The setting of these riddles is, of course, only approximate, and will have to be altered slightly for varying conditions.

“It is suggested that the linseed be harvested only in hot weather, as this will make the stripping of the seed a simpler matter. If this is done we do not anticipate trouble with any other portion of the machine, but it is necessary to watch carefully that there are no holes or crevices through which the seed can flow, as linseed, being very slippery, will leak out rapidly through any crevices of this description.”

For commercial purposes the straw is required to be an average length of about 30 inches. Unless the conditions are suitable for producing straw of this length, they cannot be considered satisfactory for the production of commercial flax fibre. The plant is measured from the butt where cut off with the reaper and binder (*i.e.*, to about 2 inches above the ground) to the top and including the seed branches. Shorter lengths of straw can be converted into excellent fibre, but the quantity of straw to be treated to produce one ton of fibre may be so much greater as to make the cost of treatment unprofitable. This is especially so as resultant fibre, being shorter, is not likely to be as valuable commercially as the longer fibre which would be obtained from the longer straw.

At one time in America the farmer grew the flax and prepared the fibre, and this was woven into linen by his wife. At the present time the farmer's work is considered to be completed when he has grown the crop and possibly thrashed the seed out of it. The preparation of the fibre is now carried out at a flax mill. Here the flax straw has to pass through several processes, *viz.*, “retting,” “breaking,” and “scutching” before commercial fibre is obtained.

“Retting,” or rotting, is a process of decay or fermentation by which the inner or woody portion of the plant is separated from the fibre. There are two ways of doing this, *viz.*, “Dew retting” and “water” or “bog” retting.

The latter is the method most generally adopted in European countries; it is quicker than dew retting. This method consists of immersing the bundles in pits, pools or streams of soft water for about 7 to 14 days, the time depending upon the softness of the water and the temperature of the weather.

Writing on the subject of retting, I. W. Seaton\* states:—

“The ‘retting’ or, literally, rotting of flax straw is a process of fermentation to which the straw is subjected as a preliminary to the extraction of fibre. Decomposition is allowed to continue until the fibre strands have been exposed by the disappearance of the outer cortical layers, and freed from the central pith by the dissolution of the pectinous substances which normally bind the two together. The pith itself is rendered more easily frangible in the process.

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\* Bailliere's Encyclopaedia of Scientific Agriculture.

"Fermentation is due to the activities of bacteria present in the plant itself. Both aerobic and anaerobic forms are concerned, the former beginning the process of decomposition and the latter continuing it. The initiation, maintenance, and speed of the action depend upon the suitability of various external conditions which affect the rate of propagation of the micro-organisms. The propagation of the bacteria is accelerated or retarded according to the temperature, chemical composition and acidity or alkalinity of the growth medium, in this case, water.

"Retting is variously carried out in ponds or tanks in which the water may or may not be slowly changed during the process, in sluggish streams or rivers, or by spreading the flax on the grass to allow of its saturation by dew, rain, or other form of precipitation.

"Pond retting in specially constructed ponds about 10 feet wide and 4 feet deep is the usual Irish method. The 'beets' (sheaves) of undeseeded flax are placed roots downward in these ponds. They are packed loosely, and set in an inclined position in overlapping layers. The whole mass of flax is then weighted down by stones or sods placed on heavy planks. A pond 36 feet long usually suffices for the crop from an acre. The water used should be soft, clean, clear and free from mineral salts which may stain the fibre. The walls of the dam possess similar staining properties, though not to any harmful extent. Blue clay tints the fibre bluish, while a yellow clay imparts a pale-yellow colour.

"With the commencement of retting the mass of flax tends to rise, and as the process nears completion it sinks. The system of weights is usually adjusted in such a way as to maintain the flax at a constant level, 2 or 3 inches, below the surface of the water. The process is complete when the stems break readily without bending, and when the fibre parts readily and completely from the pith. This, in favourable conditions and with a water temperature over 60deg. F., usually occupies eight to twelve days. Under-retting renders the subsequent mechanical processes in the production of flax more difficult, while over-retting, by the dissolution of the fibre strands themselves, will destroy their value completely.

"The process is retarded if the water of the pond is slowly changed during retting, and this variation in practice is believed to produce a better quality of fibre. Retting is much slower in new ponds than in old ones, as the organisms responsible accumulate in old ponds and survive as resting spores in the black mud which gathers on the pond bottoms. This deposit is often used as an infective material to accelerate the action of new dams. Dams are usually filled a few weeks before steeping time.

"Retting in slowly moving rivers is most successfully carried out in the River Lys, Belgium. The water of the Lys is very deep and sluggish—the flow being about three-quarters of a mile per hour. The water is soft and contains a large amount of organic matter from the towns and villages on its banks, which, together with the enormous amount of retting carried on, ensures a continuous supply of putrefactive organisms sufficient to compensate for the quantity carried downstream by the river's motion.

"Steeping extends from mid-April to mid-October, and is by no means confined to flax grown in the immediate neighbourhood. The flax beets (sheaves) are arranged, heads and roots alternately, in large wooden crates which are shrouded in coarse canvas to retard water movement through the flax. These crates are submerged 3 or 4 inches below the water surface by weights, and are moored to the river bank. Retting occupies from six to nine days according to the temperature and condition of the water.

"The water temperature in both pond and river retting varies from about 54deg. to 77deg. F., and, within limits, the rate of the process varies directly with increased temperature. This fact has led to the development of many systems of tank retting by which the water temperature and other contributory conditions can be controlled. Moreover, retting can be practised in this way in centrally situated localities and all the year round. The process was first promulgated by Schenk in America in 1846. The water temperatures used vary from 70deg. to 90deg. F., and retting may occupy as little as fifty hours, but the process is usually a costly one and the fibre produced is apt to give an inferior yarn."

Experimentally flax has been completely retted at the Washington Experiment Station, U.S.A., in 110 hours by maintaining the temperature of the water at 110deg. Fahr.

In the "Country Gentleman" of April, 1930, A. Cutting refers to the installation of flax retting tanks by the Oregon State Government wherein flax is treated commercially in slowly circulating warm water, not exceeding 84deg. Fahr. Under this new method the time of retting is reduced to four or five days, whereas formerly with cold water in tanks it took thirteen to fifteen days. In the same article he also refers to the very great success which has attended the introduction of mechanical handling plant which has reduced the cost of fibre production by two-thirds, in connection with which, flax pulling machines are of particular interest. With regard to these it is stated—"With this machine the flax is pulled up by the roots and carried upright into a binder head by three sets of inclined belts running in contact. There it is bound into eight-inch sheaves with the root ends all square across the butts. Not only does it harvest the crop cleaner than by hand, but it actually takes the place of some fifty men."

It is believed that dew retting was introduced into Australia about 1891 by Messrs. Woolf Bros., of Traralgon, Gippsland, Victoria, who are also the pioneers of the Australian flax industry.

The work of dew retting in Victoria, as described by Messrs. Woolf, consists of spreading the flax straw in straight rows about an inch thick on a clean paddock, grass for preference, but stubble will do. The flax being spread out in this way is allowed to lie for two to four weeks on one side, when the rows, by a deft process of running smooth sticks like fork handles under them, are turned over and allowed to lie for about the same time on the other side. The straw is allowed to remain exposed to the weather until the "retting" is completed. As with water retting this depends upon the temperature and also upon the weather experienced. The proper stage is reached when the inner woody stem breaks square off on being bent, and the fibre separates easily from the stalks. As retting is a process of decay which, if carried too far, will injure the quality of the fibre, it is important that the process should be stopped when the proper stages have been reached. This can only be determined by observation, and requires a skilled and experienced worker. The risk of injury is much less with dew retting than with water retting.

When the straw is sufficiently retted, it is dried and then stored for further treatment or dealt with immediately by machines known as "breakers" and "scutchers." These effect the removal of the woody useless matter from the fibre. After the breaking and scutching, the cleaned and dressed fibre is packed in bales for market. The produce from the scutcher and breaker consists of clean fibre, fine tow and coarse tow.



In America binder twine is made from flax straw, and for this purpose it is not retted but treated by a drying process which enables the straw to be converted into binder twine by one continuous factory process.

A good crop in Australia produces about 2 tons of unthrashed straw per acre, and from this will be obtained about  $6\frac{1}{2}$  centals of grain and 34 cwt. of thrashed straw. Average yields are about 30 cwt. of unthrashed straw containing about 5 centals of linseed grain and about 25 cwt. of thrashed straw.

The flax miller purchases the unthrashed straw from the grower. Prior to the war the price paid was £3 10s. per ton, and during the war £4 per ton. The following table\* shows the produce and its prewar value obtained from one ton of unthrashed flax straw in the Drouin district, Victoria:—

Produce.		Pre-War Prices.	
			£ s. d.
3 cwt. Linseed	... ..	At £14 per ton	... 2 2 0
$1\frac{1}{2}$ cwt. Fibre	... ..	.. £45 .. ..	... 2 16 3
$\frac{1}{2}$ cwt. Fine Tow	... ..	.. £10 .. ..	... 0 5 0
22 cwt. Coarse Tow	... ..	.. £5 .. ..	... 0 10 0
			£5 13 3

The yield of clean fibre given in the above table is considered by a competent authority to be a very low one and capable of considerable improvement.

In March last, Meggitt Ltd., the Australian manufacturers of linseed oil and cake (linseed nuts) were offering £12 per ton (10s. 8d. per cental) for Australian grown linseed grain, and also pointed out that normally the price of best quality Calcutta grain is £18 per ton, c.i.f. Sydney.

In Canada and the United States of America the crop is grown largely for grain alone, and there is no reason why at least sufficient for the requirements of Western Australia cannot be grown in this State: but to derive the fullest benefit from the growth of this crop the straw as well as the grain should be utilised for fibre.

When the area of linseed grown in this State warrants it, it is believed that facilities for crushing the grain and extracting the oil will be forthcoming and thus render the State independent of importations of linseed oil for paint or linseed cake for stock feeding. It is also possible that facilities for treating the fibre will also become available. This is particularly the case, as it is reported that machines have been devised for treating the straw and manufacturing the fibre without the preliminary "wet" or "dew" retting.

The advantages to the State arising out of the establishment of the flax industry and the prospects of remunerative returns to individual farmers are sufficiently good to warrant them planting small areas to ascertain the suitability of their particular holdings for the growth of this crop. No exceptional methods of cultivation are necessary; the thorough methods practised by careful growers to produce good crops of potatoes, oats, or wheat are sufficient.

\* Agricultural Research in Australia: Bulletin No. 2, Advisory Council of Science and Industry.

## EXPERIMENT ON GREEN MANURES.

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During recent years more and more attention is being paid to the subject of green manures. In years past the ploughed-in residues of weeds assisted considerably in improving the physical and organic nature of the soil, but now we have definite proof that some plants (*e.g.* Leguminosae) are better adapted for the purpose. These legumes, which include the peas, beans, vetches and lupins, have formed definite partnerships with bacteria in the soil, by which the bacteria have free accommodation in the nodules on the roots, a plentitude of water and plant food, and the only thing required of them is that they supply the legume with nitrogen. This they are able to do from supplies obtained directly from the air. Thus we see that the nitrogen derived from the decomposition of a leguminous green manure crop, is in the nature of a direct gain to the soil.

The following is a table showing the nitrogen content of various legumes:—

		Nitrogen in 10,000lbs. green crop.	Equivalent to Nitrogen in Amm. Sulphate.	
		lbs.	lbs.	
Tick Beans	...	58.0	...	547
Vetches	...	61.0	...	575
Peas	...	51.0	...	481

The above does not necessarily mean that all the nitrogen contained in the above crops will be available to the following crop, but it signifies that given proper treatment, attention being paid to ploughing in at the right time (when ample supplies of moisture are available), the chances of its loss will be minimised.

The green manure crop does not only supply a limiting factor to plant growth, namely nitrogen, but it supplies other virtues as well. Included in them are the following:—

- (1) The formation of nitrogen to the available nitrate form calls for the services of specific soil bacteria. It is obvious, then, that a copious supply of organic matter is desirable for their growth and multiplication to ensure that in succeeding years the work of nitrate formation will be earlier and better completed before the drying out of the soil inhibits their action.
- (2) The physical nature of the soil can also be greatly improved. Light sands can be built up into good soils by humus incorporation. This has been

actually done in Germany on barren lands by the use of green manure lupin crops. Heavy lands in conjunction with liming can also be greatly improved.

As a few of the virtues of green manuring have been discussed, I will now relate the progress of an actual experiment carried out in the vineyard of Mr. H. Thomas at Caversham. The objects of the experiment were as follow:—

- I. To determine the green manure crop that best suited the soil and climatic conditions of the Caversham and similar grape-growing districts.
- II. To determine the ease with which the crop could be successfully ploughed under at the right stage.
- III. To determine the quickness and completeness with which the crop decomposed when ploughed under.

*Regarding I.*—Naturally, varieties of legumes suggested themselves first of all. We saw before that they had the power of really adding to the soil's supply of nitrogen. They are fairly quick growing, and their herbage is succulent. It was then decided to test the following legumes—

- (a) Field Peas.
- (b) Vetches.
- (c) Tick Beans.
- (d) Peas and Beans.
- (e) W.A. Blue Lupins.
- (f) N.Z. Blue Lupins.
- (g) N.Z. White Lupins.

In addition to the crops of legumes it was thought that some of the cereals might have qualities other than that of the addition of free nitrogen. Of course, there are bacteria in the soil living on organic matter that can fix nitrogen themselves, and thus add to the soil's supply. The organic matter supplied by the cereals might suit them better; therefore, it was decided to try out—

- (i.) Barley,
- (ii.) Oats,

singly, and also to include them with some of the legumes, namely, oats with peas, barley with peas, and oats with vetches.

The arrangement of the plots and the quantities of seed sown per acre will be seen from the following table. The individual plots, consisting of alternate rows of currants, ran east and west and were .066 of an acre in extent. The soil was even and consisted of an alluvial silt, of fairly good quality. The slope was even, and ran east and west, and the drainage waters were encouraged to escape by the fact that the ploughing was turned on to the vines. Consequently it was found that little damage was done by standing water.

The seed was sown on the 22nd May, 1931, in seed beds that were well ploughed and in a good state of tilth. Prior to seeding, superphosphate at the rate of  $3\frac{3}{4}$  cwt. per acre had been applied.

The following table traces the history of the plots from germination to incorporation within the soil:—

GREEN MANURING EXPERIMENT, 1931.  
STATEMENT No. 1.

Green Manure Crop.	Seeding Rate per acre.	Planted.	Germinated.	Ploughed in.	Stage of Growth.	Weight Plots.	Weight per acre.	Mean of Controls.	Gain or Loss.	Remarks.
Field Peas, Control	2 bushels. ...	22-5-31	4-6-31	14-9-31	Formation first pods	tons. 825 cwt. 12 9-98	...	...	cwt. 8-4	The rows were E. and W. In every case the S. sides were more advanced.
Peas and Tick-Beans	1 of each	...	6-6-31	...	do. flowering	8,091	12 5-18	...	cwt. 13-2	This crop came away well from the start. The E. end was slightly affected by water. This lowered the yield slightly. Lucerne Flee was fairly abundant, also slugs.
Tick Beans	2	...	6-6-31	...	Flowering	7,880	11 9-18	ton. 12 15-98 cwt. 19-2	...	The two crops came away well and presented a fine appearance. The beans appearing in peas. There were less Lucerne Flee and slugs, and work of ploughing was rendered easy on account of the beans firm hold.
Vetches	1½	...	2-6-31	14-9-31	Flowers not apparent	7,616	11 10-78	...	ton. 7-6	This crop also promised well from the start. Beans were ½ to 5½ ft. in height, succulent, and their firm hold enabled them to be ploughed in easily despite their height and bulk.
Field Peas, Control	2	...	4-6-31	...	First Pods	8,804	13 6-78	...	cwt. 8-4	Germination and growth were excellent. The plants 2½ ft. much branched, formed a dense carpet-like growth. Ploughed under with ease. These plants have a very firm hold. There were less Lucerne Flee and slugs, and a noticeable feature was the dense mass of fleshy roots in the ground.
Vetches and Oaks	1 and 2½	...	2-6-31 1-6-31	...	Flowers not apparent	...	...	...	...	Similar to the first control, but growth was more even. These plants have a fragile hold in the ground. This made ploughing in extremely difficult. Unfortunately this was impossible. The coulters on the Oliver Plow was ineffectual.
The following plots were not weighed										
						Vetches made good growth except at the W. end, where the soil was so somewhat shallow and suffered through excess water. The oats were not up to expectations although they did better here than by themselves. Since the 31-8-31 they improved greatly, and may yet have yielded well but then would have been useless for a green manure crop.				

W.A. Blue Lupin ...	30lbs. ...	...	22-5-31	10-6-31 Max. 24-6-31	14-9-31	Flowers just showing	This plot was a failure. Germination was erratic and prolonged; growth was poor. Nodule formation was apparent. They commenced to show some improvement from the 31-8-31 where somewhat higher temperatures were recorded. The bacterial nodules were concentrated on at the tap root, a fraction of an inch below the base of the stem.
N.Z. White Lupin ...	50lbs. ...	...	...	1-6-31 Max. 24-6-31	...	Minimum flowering	Germination promised well. It was fairly even. Growth, however, remained stationary till the 31-8-31. On the 14-9-31 there was a great improvement, but the greater was between the 14-9-31 and the 18-9-31. Unfortunately the stunted N. side mitigated against their being weighed. The bacterial nodules were all situated on the lateral roots, somewhat the size of a pea. Rows running N. and S. may give more favourable results.
N.Z. Blue Lupin ...	50lbs. ...	...	...	do.	...	do.	Germination was fairly good. They showed the same responses to late growth as did the white lupins. Their foliage is, however, more scanty and thicker sowings would have to be resorted to. Their bacterial nodules are borne at the base of the stem and a few small nodules on the lateral roots, which were not so freely produced as the white lupins.
Field Peas, Control	2	...	...	4-6-31	...	First Pods ...	Growth here was parallel to the other controls.
Peas and Oats	1½ and 4	...	...	4-6-31 1-6-31	...	do. Flowers not apparent	Peas were excellent, but the oats, as with the vetches, failed to respond, although they were better than the oats by themselves.
Peas and Barley	1½ and 3	...	...	do.	...	First Pods - In ear	The barley in this plot apparently suffered more through lack of warmth. The plan's were stunted and remained yellow in colour even on the 18-9-31 when they were in ear.
Oats ...	4	...	...	1-6-31	...	Ears not apparent	Till the 31-8-31 this plot was yellow in colour and stunted in growth. From that date to the 18-9-31 the plants improved greatly in size and colour, but did not warrant weighing.
Barley ...	3	...	...	do.	...	In ear ...	This plot remained yellow and stunted. Indications of earing occurred on the 31-8-31.
Field Peas, Control	2	...	22-5-31	4-6-31	14-9-31	First Pods ...	This plot was as uniform as the other controls.

Unfortunately, as seen from the statement, the cereals and lupins failed to come up to expectations. Judging by various crops in the vicinity I came to the conclusion that the particularly cold and cheerless weather was in the main to blame. It is interesting to note that the shelter afforded by the cover crop somewhat improved their growth and condition.

With regard to the lupins, the cold weather was again instrumental in checking their growth, together with an insufficiency of the specific nodule bacteria in the early stages of their growth.

On the 14th September, with the advent of a little warmth, the plants, especially the New Zealand varieties of lupins, immediately responded, and had it been possible to retard the time of ploughing, indications pointed to the fact that a considerable amount of material would have been returned to the soil. However, it was too late.

The failure of these crops emphasises the fact that a green manure crop must not be too susceptible to variations in the climatic conditions. In other words, it must be reliable.

The following is an analyses (taken from "Feeds and Feeding" by Henry & Morrison) of the following crops—

	Per cent. dry matter.	Amount in 10,000lbs. green material of		
		Nitrogen.	Phosphoric Acid.	Potash. Potash.
Tick Beans ... ..	17.6	58	12	37
Peas ... ..	18.8	51	12	32
Vetches ... ..	20.4	61	16	50

Applying these analyses to the results obtained, we have—

Crop.	Weight per acre.	Dry matter.	Nitro- gen.	Equiva- lent to Nitrogen in Am- monia Sulphate.	Phos- phoric acid.	Equiva- lent to phos- phoric acid in Super.	Potash.	Equiva- lent to Potash in Sulphate of Potash.
	tn. ct.	cwts.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Tick Beans...	12 0	42	156	735	32	286	99	185
Peas...	12 16	48	146	688	34	304	92	170
Vetches ...	11 11	47	157	740	41	366	128	237

It is significant to note that crop bulk, irrespective of variety of crop, does not determine the composition of the nitrogenous and mineral material contained in the crop.

Vetches returned more material to the soil than did either the pea or bean plots, yet they returned less total green bulk.

I previously emphasised the fact that the nitrogen obtained from the leguminous green manure crop is more or less in the nature of a complete gain to the soil. The organic nitrogen of the crop is obtained from the nodule bacteria and built up into plant tissues. On the decay of these tissues the organic nitrogen is converted by the specific action of certain other bacteria to the nitrate form of nitrogen which usually exists in the form of a calcium nitrate. The organic material incorporated also stimulates the growth of other bacteria, some of which have the power of directly fixing nitrogen from the air. On the death of their bodies nitrates are eventually produced.

Turning our attention now to the minerals obtained in the crop, it is obvious that they were obtained from the soil and that they are going back into the soil. The roots of these crops have ramified through considerable areas of soil, collecting phosphoric acid and potash, etc., and other substances in solution from far and wide. These substances are especially concentrated in the growing and fleshy portions of the plants. Now, it seems most probable that these minerals, when set free by decomposition, are in an ideal place, for the feeding roots of the vine are essentially shallow.

## II.—*The ease of ploughing under.*

The ease of ploughing under a green manure crop carries an instant appeal to all engaged in viticultural pursuits, and justly so. An easy burial, especially when well done, saves time and money, and consequently is one of the factors that contribute to ultimate success or failure.

When we consider the ease of ploughing under the various crops we see that some are much easier to manipulate than others. For example—

*Field Peas* were extremely difficult to plough in. In that case I think the principal cause was the fact that the peas had a very insecure hold in the soil which resulted, on ploughing, that accumulations of material choked the plough, caused incomplete burial, and incidentally tried the patience of the operator. Therefore, we must bear in mind that material incompletely buried only partially decomposes, and the purpose for which the crop was planted is, therefore, not consummated.

*Tick Beans* were fairly easy to plough in, and only small amounts of material protruded from the central furrows. I have seen that when, prior to ploughing, the beans are knocked down by the reversed harrows, the actual work of ploughing has been rendered more easy, and that also the incorporation of the crop has been better done.

*Beans and Peas.*—These two legumes grew well together. The beans easily supported the peas, and thus made the work of ploughing under fairly easy, and resulted in a more efficient burial of the crop.

*Vetches.*—This crop was particularly easy to plough under. This was due to the particularly firm hold that the vetches had in the soil.

From the above observations it will be seen that the ease of ploughing under of the various crops is as follows:—

- (a) Vetches.
- (b) Tick Beans.
- (c) Beans and Peas.
- (d) Peas.

## III.—*Decomposition.*

The plots were ploughed on the 14th of September to a depth of 9 inches. From the beginning of September to the incorporation of the green manure crops 85 points of rain fell. The ground was still moist and had not dried out through the transpiration of the crops. From the 14th of September to the 2nd October 115 points were recorded, and from the 2nd October to the 5th November 138 points of rain fell. On all these dates samples were taken, and the processes of decomposition studied.

*Field Peas.*—On the 2nd October, 1931, I found that the lack of uniformity in ploughing made it somewhat difficult to obtain even samples; however, decomposition had proceeded rapidly: the leaves, tendrils and the extreme upper stems had completely lost their form, and consisted of green slimy masses of material. The lower lignified stems were entirely unaffected, while the major parts of the upper stems were reduced to vascular skeletons. The few pods were unaffected.

Where the plants had been buried completely, their large moisture content 81.2 per cent., had considerably hastened the processes of decay, but those incompletely buried had dried out only. On the 15th October I was surprised to see no noticeable advancement in decomposition. The ground was obviously moist, but one did not see the oozy masses one saw on the first visit. The concentration of water had been lowered, thus checking decay. In most of the plants their whole vascular framework could be made out—only the *parenchymatous tissues had been changed*.

On the 5th November no further advancement was to be seen.

*Vetches*.—On first sampling on the 2nd October, 1931, this crop seemed to have lost more bulk than the others. The decay of the parenchymatous tissues was very active, and as lignification had not proceeded to such an extent, due to the fact that the crop was in a less advanced state of maturity, decomposition was more general. On subsequent visits no further progress was noticed, leaving the vascular frameworks of the plants in the majority of cases quite intact. The residues were, however, extremely light.

*Tick Beans*.—On the 2nd October, 1931, decomposition was very active in the succulent parts of the plants, but these were restricted to the leaves and extreme apical portions of the stems. The major parts of the stems, though not lignified to any great extent, were entirely unaffected and were quite as green as the day they were ploughed in. The rate of decay appeared to be directly correlated to the concentration of water contained in the plant tissues.

On the 15th October, 1931, it was found that decomposition had commenced on the stems. These were blackened, but the decay was only superficial and had apparently ceased before my visit. In some cases the decomposition of the parenchymatous tissues had not been completed, though the soil conditions were excellent, and compared more than favourably with well prepared fallows found in other parts of the district.

On the 5th November, decomposition was found to be no further advanced and it was obvious that incorporated in the soil was a large amount of woody material.

To further compare the rate of decomposition of the various crops two areas of six square yards were dug up in each plot and the material sifted out and weighed. This was done in the vetch and bean plots, but, unfortunately, due to incomplete burial it was impossible to do this with the pea crop.

#### VETCHES.

	lbs.
Average weight two weighings of dried decomposed material ...	2.25
Average weight two weighings of green crop ...	33.625
Average calculated to dry weights ...	6.75
Approximate loss of weight through decomposition ...	4.5
Percentage loss ...	67%

#### TICK BEANS.

	lbs.
Average weight, two weighings of dried decomposed material ...	4
Average weight, two weighings, of green crop ...	34.37
Average calculated to dry weights ...	6.05
Approximate loss of weight through decomposition ...	2.05
Percentage loss ...	34%

These figures cannot be taken as scientifically correct, but, nevertheless, they approximate closely to observations made in the field.

The residual material of the bean crop was considerable. It not only included the lignified lower stems, but, in addition, the extreme basal portions of the plants and the adherent roots, which were not included in the initial weighing for the green crop bulk. On the other hand, the vetch residues, with a minimum of lignification, were light, showing that decomposition was more complete.



Though this experiment was not as comprehensive as it might have been, it demonstrated, however:—

- (a) That certain crops are not suitable for general use as green manures for the conditions under which they were tested. It is necessary to have in mind the fact that the green manure crop must be dependable for all conditions: therefore, we can safely assume that barley, oats and the lupins are not satisfactory for the purpose.
- (b) That peas, tick beans and vetches made excellent growth.
- (c) That tick beans and vetches could be easily and completely incorporated in the soil, while the heavy crops of peas could not be readily buried. The peas, therefore, are an uneconomic loss through not serving the purposes for which they were used. Discing prior to ploughing would ensure a better burial of the green material, but on the smaller farms this would be impossible owing to lack of proper implements.
- (d) That vetches decomposed much more readily than did either the beans or peas, and from the analyses they contained more nitrogen, phosphoric acid and potash than did the other crops. The question of the maturity of the crop when ploughed in, is very important—from the chart it will be seen that the vetches had not commenced to flower, that the beans had, and the latter is the stage that is usually recognised as the best time to plough in.

I am convinced that the deciding factor in complete and economic decomposition is the presence of a high percentage of parenchymatous tissues in the crop, together with a high percentage of moisture. This stage has already passed when the crop is flowering.

The nitrogenous, phosphoric and potassic material are especially concentrated in the rapidly growing tissues, and it follows that a rapid decay will ensure that these materials will be readily available for the vine or tree as the case may be. It is hoped that experiments will be conducted next year to confirm these statements. Other factors affecting green manure crops are the following:—

- (1) The retarded ploughing in of a crop may, especially if succeeded by dry conditions, seriously injure the vines, through—
  - (a) excessive drying out of the soil by the green manure crop through transpiration;
  - (b) failure of the crop to adequately decompose, thus causing further drying out of the soil;
  - (c) loss of plant requirements contained in the lignified and undecomposed residues;
  - (d) waste of time and money if the green manure crop does not serve the purpose for which it was intended.
- (2) Green manuring is recognised by the leading Agricultural countries of the world as a fundamental for the successful growth of horticultural and viticultural crops. It also enables the phosphoric and potassic fertilisers to be applied in the autumn, when the green manure crop is sown, thus improving that crop, and permitting the major crop to benefit more fully from the fertilisers than when they are applied in the spring.

In conclusion, I would like to thank Messrs. Wilson & Johns and Mr. William Padbury for their generosity in supplying seed; Mr. Thomas for the use of his vineyard for the experiment and for his sustained interest, and the Members of the Midland Junction Horticultural Classes for their co-operation.

## CREAM CHEESE.

G. K. BARON-HAY, Superintendent of Dairying.

During the last few weeks a large number of inquiries have been received from farmers as to a method of making cheese on the dairy farm for home consumption.

The manufacture of Cheddar cheese is a highly technical process, and requires special machinery and experience in operation.

Cream cheese, however, calls for very little special apparatus, and, with care, a highly palatable and nutritious article may be produced on any dairy farm.

The following articles are required:—

One 2-gallon enamel bucket.

2 smaller buckets for straining,

A supply of fine dairy salt,

Rennet, either tablets or liquid,

Ladle,

4 huckaback straining cloths, 2 feet square,

A dairy thermometer,

Several cheese moulds—any empty tins of a suitable size may be used,

A supply of cheese cloth for lining moulds.

For the production of cheese it is essential that cleanliness should be observed in the handling of milk during milking, separation, and in all processes mentioned for the manufacture of the cheese. Milking utensils must be clean and sterile, every utensil with which the milk or cream comes into contact being properly washed in boiling water before using same.

The cream selected for cheese-making should be fresh, and should have a butter fat content of approximately 15 per cent. As the use of the farm separator is general in this State, and a butter fat content of 40 per cent. is the aim in separation, it will be necessary to break down the butter fat content of such cream before treatment for the making of cream cheese. Fresh skim milk may be used for breaking down the cream, for which, however, a simple calculation is required for the quantity of skim milk to add to the cream in order to obtain the desired result of 15 per cent. butter fat in the final product. The square method below will be found the most convenient.

This method gives the proportions in which the cream is separated, and skim milk should be mixed in order to produce a product containing 15 per cent. butter fat.

A suitable quantity of cream with which to work is two gallons, or about 20 lbs., which will make approximately  $7\frac{1}{4}$  lbs. cream cheese.

After the cream testing 15 per cent. butter fat has been produced, this should be brought to a temperature of approximately 80deg. Fah. It will be found that if separation is carried out soon after milking, the temperature will approximate this figure. When at this temperature, for about 20 lbs. cream a starter of  $\frac{1}{2}$  cup of sour cream, having a pleasant flavour, should be added and well stirred. Then

the cream should be allowed to stand for several hours until a distinctly acid flavour may be detected, but no curdling has taken place. The acidity will then be from .18 to .22 per cent.

In Western Australia, particularly during the summer months, the addition of a starter is unnecessary, as on keeping cream for from 12 to 24 hours, depending on the atmospheric temperature, an acidity of the figure mentioned will be developed naturally, and, if cleanliness has been observed in the production of the cream, this acidity should be of a desirable character.

**Rennet**, to coagulate the casein, is now added, 2 gallons of cream requiring 40 drops of rennet, which should be mixed in a small wineglass of clean water and poured slowly into the cream, stirring well while adding to ensure thorough mixing. This should be done in a perfectly clean enamel bucket. The cream is now allowed to stand for from 1½ to 2 hours until the curd is firm. Firmness may be tested by drawing the finger or a glass rod through the curd which should break cleanly without any dragging. When this stage is reached the cream is ready for straining. The curd should now be removed from the whey or liquid portion with a skimmer or ladle, and laid gently on straining cloths which should line one or more buckets in readiness for straining. Huckaback towelling, about 2 feet square, has been found a suitable material to use as strainers. The straining cloth is now tied around the curd, which should be hung for 24 hours to allow the moisture to escape. When the mass is fairly well drained the cloth should be changed, fine salt added to the curd, then rewrapped and put under slight pressure for a few hours. The percentage of salt to add depends on the taste of the manufacturer, 1½ per cent. being found most popular, or 27 ounces for the amount of cream being used, *i.e.*, 20 lbs. producing approximately 7¼ lbs. cream cheese.

The degree of pressure and the length of time to be kept under this pressure will be indicated by the condition of the curd. A soft curd which would have been developed where the acidity was low would need approximately 8 lbs. pressure for 8 hours, while a fairly dry firm curd produced where the acidity was high might require only 4 lbs. for 4 hours. A brick weighs approximately 4 lbs., and may be used for weighting, being placed over a piece of wood, beneath which is the cheese securely wrapped in the huckaback towelling used for straining. Pressure should be removed when the curd is sufficiently dry, and the curd moulded into some suitable form. Shallow cylinders, from 1½ to 2 inches deep and 3 inches across, which will contain 7 to 8 ounces of cheese, will be found suitable. These moulds should be lined with cheese cloth before the cheese is pressed into them, which assists in lending firmness to the resulting cheese.

Cream cheese made by this method is extremely palatable, but will not keep for long periods, and should be used within a few days of being manufactured.

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## DENTITION OF SHEEP.

H. McCALLUM, Sheep and Wool Inspector.

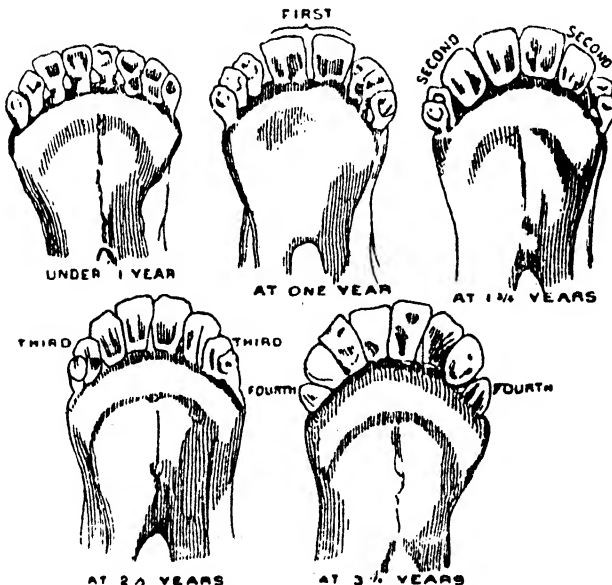
A most important matter in connection with sheep farming is that of judging the age of the animals. This is usually estimated from the condition of the eight incisor teeth in the front of the bottom jaw. However, misunderstanding sometimes arises when the exact age of the animal is required, and the better method when offering sheep for sale is to state the date of dropping. This information is not always available, and the following description of the sheep's mouth from birth to maturity will be useful to those whose knowledge of sheep is slight.

A full-mouthed sheep has thirty-two teeth, eight incisors, and twenty-four molars, six on each side of both jaws. The incisors are for nipping off the food and the molar teeth are used for mastication, their surfaces being irregular and suitable for grinding.

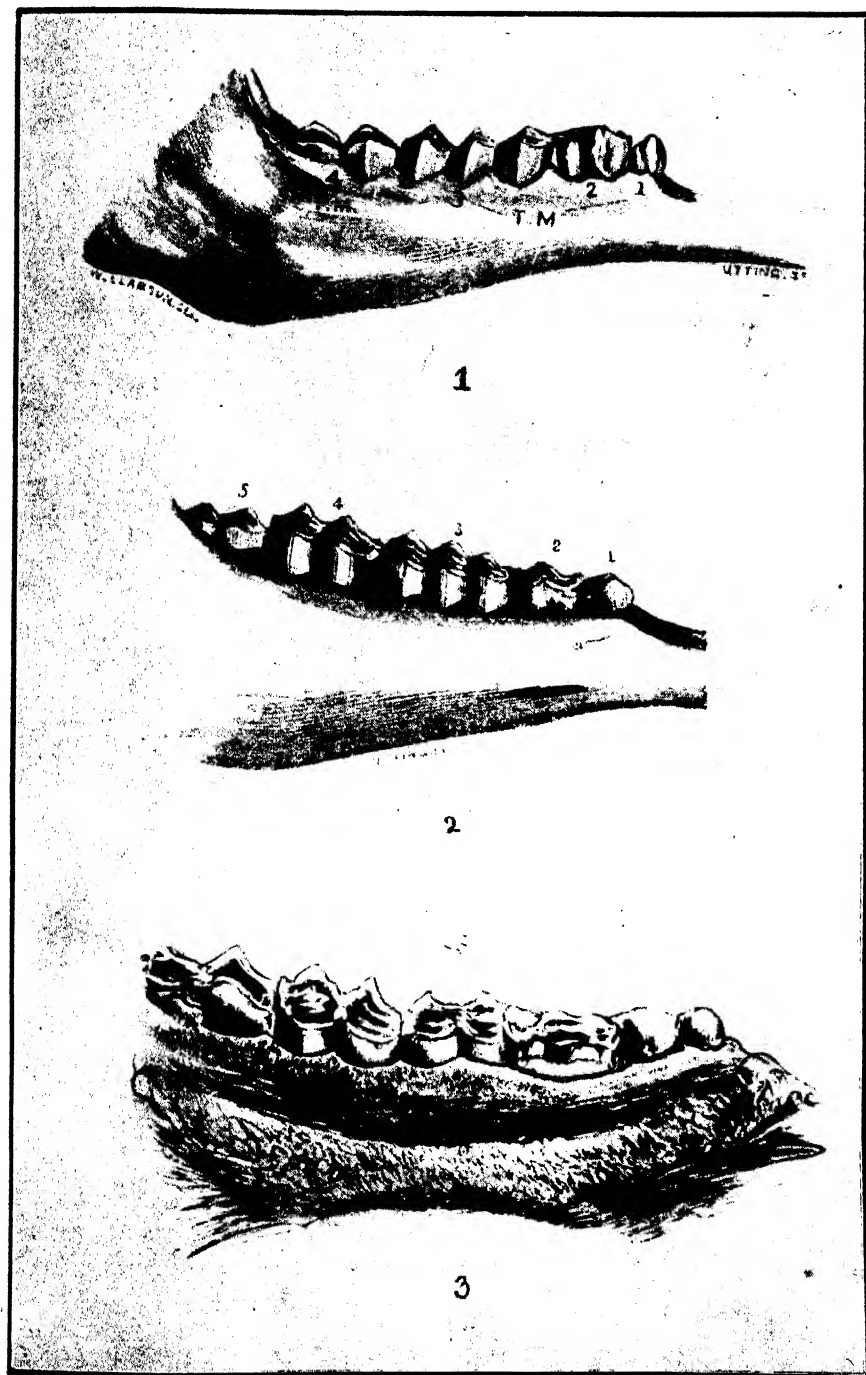
The teeth develop in two lots; the first set is temporary and consists of eight incisors and three molars on each side of both jaws, all of which are up by the time the animal is two months old. At from twelve to fifteen months onwards these teeth are gradually replaced by corresponding permanent ones.

At birth a lamb possesses two temporary central incisors, and at the end of four weeks all the eight temporary incisors are up with usually three molars in each of the upper and lower jaws (first, second and third temporary molars); at three months the fourth, and permanent, molar is cut; at nine months the fifth, also permanent, molar makes its appearance; and at eighteen months the first and second temporary have been pushed out by the corresponding permanent molars, the third is covered by the third permanent, and the sixth permanent molar is cut. Thus a sheep has all its permanent molars up at from eighteen months to two years.

With the incisors, the first two, or central permanent teeth, make their appearance at from twelve months in early to fifteen months in late dentition.



Dentition—Incisors.



Dentition—Molars.

1. Molars at 3 months. 2. Molars at 9 months. 3. Molars at 2 years.

The sheep is then known as a "two-tooth" or "hogget." At two years of age the two teeth on either side of the central teeth are replaced by two permanent teeth. The sheep now becomes a "four-tooth." At three years of age the two third permanent teeth replace the corresponding temporary ones and the sheep is said to be a "six-tooth." At four years the last two permanent incisors appear, and the sheep is then an "eight-tooth" or "full-mouthed."

From this time onwards the age of a sheep cannot be accurately determined by the teeth. From about five years onwards the central teeth will show signs of separating in the middle, and as the sheep ages, other teeth will separate and may be broken. With age, the teeth become worn down or lost and the sheep is then known as "broken-mouthed." In the case of broken teeth it is wise, if only three or four or fewer teeth remain, to pull them out and leave the animal "gummy." A sheep cannot bite with odd or gapped teeth as well as it can with the gums.

Sheep have been known to retain good teeth until an old age. The wear of the teeth, like their development, depends on the class of country, climatic conditions, the early or late maturity of the breed, and whether the mouth is defective or of good shape.

Old sheep should not be purchased or pastured when younger ones are procurable. Further indications of old age are sagging of the loins, distended nostrils, and deterioration of the fleece in quality and quantity.

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## OBITUARY.



The late W. T. Richardson.

Since the publication of our last issue the "Journal" has suffered a sad loss in the decease of our esteemed colleague and contributor, the late Mr. W. T. Richardson, Poultry Adviser to the Department of Agriculture. He was a personality of wide and varied experience, genial, courteous, and highly respected by all with whom he came in contact, and his helpful advice and instructive articles appearing in these pages from time to time were a source of great interest to those engaged in the poultry farming industry.

Born at Barcelona (Spain) on 3rd June, 1874, his business training began in England in connection with the overseas departments of several big mercantile houses. Later in life he adopted Western Australia as his home, and engaged himself in the pastoral industry of the North-West, being at times musterer, boundary rider, horse-breaker, and eventually manager of stations there. It was at Kalgoorlie he first took up poultry farming, and established what was then the largest farm of its kind in the State. Transferring his activities to Canning, the late Mr. Richardson received his appointment to the Department of Agriculture in October, 1926, and his property was converted by him into an experimental farm for the benefit of the industry.

During the great War, Mr. Richardson joined up with the 10th Light Horse, and saw service in Egypt, Palestine, and Jerusalem, right through the Sinai campaign. He was an exemplary citizen, and with all his varied experiences he preserved a quiet, unassuming manner that made him a popular favourite.

**PRODUCERS' MARKETS CO-OPERATIVE, LIMITED.****QUARTERLY REPORT FOR PERIOD ENDING 15th NOVEMBER, 1931.**

*Fruit:* Supplies of fruit at the beginning of the quarter were only moderate, consisting mostly of citrus fruit.

Values for Navels were only fair; heavy supplies of falls and inferior fruit being marketed. Lemons were particularly dull, there being no demand whatever during the quarter. Valencias were also marketed during the first of the quarter, but were of poor colour, and met with very little support.

Apples of small grades were plentiful and values low. Toward the end of the quarter, with weather conditions improving, values also improved and many early varieties of fruit made their appearance.

Local Tomatoes touched the exceptionally high price of 45s. per  $\frac{3}{4}$  bushel, while Strawberries, Cherries and early Apricots and Peaches were supplied. With the exception of Granny Smith, apple values continue at low rates, only very slight improvement throughout.

*Vegetables:* Supplies of vegetables have been good. Potatoes were in good demand and values uniform. Main crops are not yet on the market, but indications are that values will be considerably better than last year. Pumpkin supplies shortened and values for prime lines increased. Swedes were plentiful and values in the main were low. An odd line of choice stuff would command higher rates. Cabbage was steady in supply and value. Cauliflowers were plentiful early in the period and the demand good, values being high for prime lines. During the last month, however, supplies ceased. Peas were heavily supplied from the Metropolitan area, and values were at glut level. French beans and Runner beans are forward now in fair quantities and the demand good. Rhubarb supplies were plentiful and values good throughout. Bunch lines, heavily supplied, and all lines except turnips, sold to a good demand. Lettuce of good quality in good demand all through the period.

*Eggs:* During the quarter under review heavy supplies came forward both from the metropolitan and country districts, with the result that the demand was not equal to the supply and prices eased. To relieve the market, growers continued to export every available egg, and by so doing kept prices reasonably firm, ranging from  $7\frac{1}{2}$ d. to  $9\frac{1}{2}$ d. As the egg industry was passing through its "peak" period supplies showed a further increase, and as a consequence prices dropped to  $6\frac{1}{2}$ d. for Metropolitan new laid. This drop, together with the favourable exchange position with regard to export had the desired effect of making growers realise their responsibility to the egg industry, and the additional quantities packed for export again firmed, the market leaving it now firm at prices ranging from 8d. to  $10\frac{1}{2}$ d. During this period we, as export agents for the Westralian Farmers, Ltd., Fremantle, accepted large quantities for export at an advance of 7d. per dozen.

*Poultry:* Supplies from the middle of August to the second week in October (Show Week) were heavy, with keen competition and good prices for all prime lines. Turkey gobblers and turkey hens were heavily supplied and, considering bad times, realised good values. Gobblers up to 24s. and turkey hens 13s. 9d. a



pair Muscovy ducks and drakes also sold well at values up to 7s. 6d. and 13s. respectively. Prime cockerels were in demand at prices up to 10s. 6d. a pair. Inferior lines were hard to quit. After Show week up till the first week in November supplies were light with the quality poor throughout—too many aged and half-grown birds being marketed. The quality of the birds was not up to the requirements of the trade. Turkeys, Muscovy ducks and drakes have been short supplied with good inquiries and values for prime quality. During the past week supplies have improved both in quality and number and promise to continue from now on until Christmas.

*Carcase Meat:* Pork, veal, and beef short supplied with good inquiries for prime carcasses. Lamb and mutton during August were heavily supplied with good prices realising for prime lines and poor quality hard to quit. In the early part of September supplies were short and sold well to a keen demand. The firmness of the market was instrumental in making producers forward larger consignments with the effect of again weakening the market. From the middle of September till now supplies have varied. Apparently consignors studied the market and consigned when the time was most opportune for good values. Throughout the quarter under review pork, veal, and beef have maintained their values, but lamb and mutton values varied from sale to sale in accordance with quantities consigned.

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## METEOROLOGICAL INFORMATION.

[illegible]

## WESTERN AUSTRALIA—DEPARTMENT OF AGRICULTURE.

## LIST OF BULLETINS AVAILABLE FOR DISTRIBUTION.

- No. 20.—*The Pruning of Fruit Trees*. J. F. Moody. Price 2s. 6d.  
 No. 24.—*Hints to Stock Breeders* (revised). R. E. Weir.  
 No. 37.—*Conference of Producers, 1910 and 1912*.  
 No. 46.—*Fruit Packing and Marketing and Exporting of Fruit*. J. F. Moody and J. Ramage. Price 1s. 6d.  
 No. 49.—*The Feeding of Horses*. Professor Paterson and G. L. Sutton.  
 No. 57.—*Vermis Destruction*. A. Crawford.  
 No. 60.—*The Farmer's Clip*. J. J. Mahood.  
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 No. 74.—*Tobacco Cultivation*. A. R. C. Clifton.  
 No. 79.—*Sheep on the Wheat Farm and their Management in W.A.* H. McCallum.  
 No. 83.—*Horticulture and Viticulture*. A. Despeissis. Price 2s.  
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 No. 90.—*Stock Waters: Standard for Composition of*. E. A. Mann.  
 No. 91.—*Dairy Premises*. P. G. Hampshire.  
 No. 93.—*The Home Tanning of Sheep and other Skins*. H. Salt.  
 No. 96.—*Poison Plants of W.A.* D. A. Herbert.  
 No. 99.—*Australian White*. G. L. Sutton.  
 No. 101.—*Cotton Cultivation*. G. L. Sutton.  
 No. 103.—*Kerosene Method for Eradicating Zamia Palm*. G. K. Baron-Hay.  
 No. 105.—*Pedigree Selection of Seed*. G. L. Sutton.  
 No. 106.—*The Red Legged Velvet Earth Mite*. L. J. Newman.  
 No. 112.—*Automatic Device for Eradication of Stickfast Flea*. G. Allman.  
 No. 113.—*Clipping Pieces: Classification of Clip*.  
 No. 114.—*Blue Mould on Citrus Fruits*. W. M. Carne.  
 No. 115.—*The Value of Windmills for Pumping Water in W.A.* A. H. Scott.  
 No. 117.—*Cream*. P. G. Hampshire.  
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 No. 192.—*Root Rot*. A. J. Despeissis.  
 No. 220.—*Irrigation and Drainage*. A. H. Scott.  
 No. 221.—*Soudan Grass*. G. L. Sutton.  
 No. 225.—*Subterranean Clover*. G. K. Baron-Hay.  
 No. 238.—*The first Australian Studmaster—His Flock*. G. L. Sutton. (Reprint from "Journal.")  
 No. 239.—*Field Experiments, Chapman*. I. Thomas (Reprint from "Journal.")  
 No. 241.—*Field Experiments, Merredin*. Langfield (Reprint from "Journal.")  
 No. 242.—*Field Experiments, Avondale*. Wild and Bailey. (Reprint from "Journal.")  
 No. 243.—*Successful Codlin Moth Control in W.A.* G. W. Wickens. (Reprint from "Journal.")  
 No. 245.—*Leaf Rust of Stone Fruit*. W. M. Carne. (Reprint from "Journal.")  
 No. 246.—*Field Experiments—Wongan Farm*. I. Thomas. (Reprint from "Journal.")  
 No. 249.—*Phosphate or Phosphoric Acid*. G. L. Sutton. (Reprint from "Journal.")  
 No. 250.—*Sheep—Hand-feeding*. H. McCallum. (Reprint from "Journal.")  
 No. 251.—*Rutherglen Bug*. J. L. Newman. (Reprint from "Journal.")  
 No. 252.—*Worms affecting Sheep*. H. W. Bennetts. (Reprint from "Journal.")  
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- No. 285.—*Potato Diseases in Western Australia.* H. A. Pittman. (Reprint from "Journal.")
- No. 287.—*Variation in the Weight of Eggs.* W. T. Richardson, Poultry Adviser.
- No. 288.—*Pastures. In Areas of Medium Rainfall.* G. K. Baron-Hay, Assistant Superintendent of Dairying.
- No. 289.—*The Unsound Economics of the F.A.Q. Standard for Selling Australian Wheat.* Geo. L. Sutton.
- No. 290.—*Wax Scale (Ceroplastes Ceriferus),* Anderson. L. J. Newman, F.E.S., Entomologist; B. A. O'Connor, B.Sc. Agr., Agricultural Advisor; and H. G. Andrewartha, B.Sc. Agr., Agricultural Advisor.
- No. 291.—*"Early Blight" or "Leaf Spot" and the Macrosporium "Storage Disease" of Potatoes.* H. A. Pittman, B.Sc. Agr., Plant Pathologist.
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- No. 333.—*The Centrifugal Cream.* G. K. Baron-Hay.
- No. 334.—*Sugar Beet and its Cultivation.* G. L. Sutton.
- No. 336.—*Seed and Seed-Bed Disinfection.* H. A. Pittman.

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*The Handbook of Horticulture and Viticulture of Western Australia*, by A. Despicssis, M.R.A.C.:

This publication contains valuable information dealing with all commercial fruits grown in Western Australia, including advice on planting, pruning, packing, manuring, fruit-drying, wine-making, insect and fungoid pests and their treatment, etc., and the whole forms a text book which every fruitgrower, whether large or small, should have in his possession. The price originally was 8s. 6d., but to allow of distribution being as wide as possible it has been reduced to 2s.

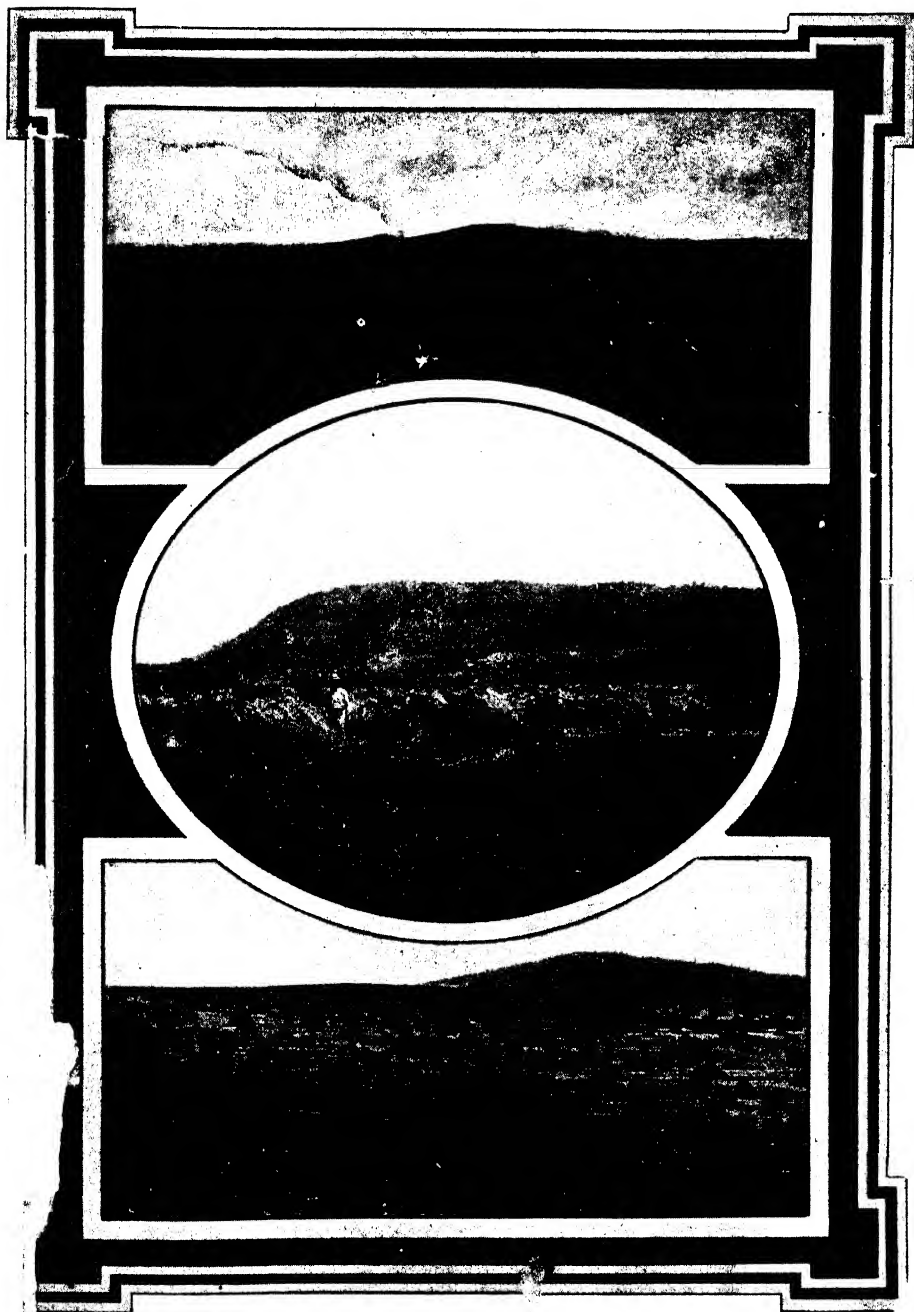
*The Pruning of Fruit Trees*, by J. F. Moody, Fruit Industries Commissioner:

This publication contains numerous illustrations, being reproduction of photographs taken in this State, of pruned and unpruned trees, which make the details set out in the letterpress particularly easy to understand. Price 2s. 6d.

*Fruit Packing and the Marketing and Exporting of Fruit*, by J. F. Moody, Fruit Industries Commissioner, and J. Ramage, Packing Instructor:

This publication contains invaluable information on packing and grading fruit for local and export markets. It is freely illustrated, and no fruit-packing shed should be without a copy. Price 1s. 6d.

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